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FEDERAL ENERGY R&D PRIORITIES

COMPLETED ORIGINAL

HEARING

BEFORE THE

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS

AND THE

SUBCOMMITTEE ON ENERGY RESEARCH AND PRODUCTION

OF THE

COMMITTEE ON SCIENCE AND TECHNOLOGY U.S. HOUSE OF REPRESENTATIVES

NINETY-SEVENTH CONGRESS

SECOND SESSION

MARCH 5, 1982

[No. 89]

Printed for the use of the
Committee on Science and Technology

Y4.Sci2:97/89

U.S. GOVERNMENT PRINTING OFFICE
94-079 O WASHINGTON : 1982

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*On assignment to Budget Committee for 97th Congress.

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FEDERAL ENERGY R. & D. PRIORITIES

FRIDAY, MARCH 5, 1982

HOUSE OF REPRESENTATIVES, COMMITTEE ON SCIENCE AND TECHNOLOGY, SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS, JOINTLY WITH SUBCOMMITTEE ON ENERGY RESEARCH AND PRODUCTION,

Washington, D.C.

The subcommittees met, pursuant to notice, at 9:30 a.m., in room 2318, Rayburn House Office Building, Hon. Don Fuqua (chairman of the Subcommittee on Energy Development and Applications) presiding.

Mr. FUQUA. The committee will be in order.

Yesterday, we heard Secretary Edwards present DOE's budget request for 1983. Many questions were raised about the budget and its implications for our energy security and international competitiveness in energy technology markets.

Last year was a time for both the administration and the Congress to reassess the Federal role in energy research, development, and demonstration. The 1983 request insures that the assessment and the debate between Congress and the executive branch will continue.

The Department of Energy has recently received from its own Energy Research Advisory Board a report entitled: "Federal Energy R. & D. Priorities," which includes provocative findings and recommendations.

The subcommittees want to explore the implications of the ERAB report for the scope, balance, and funding levels of Federal energy R. & D. programs as part of our budget review. In addition, since the administration has decided not to take all of its advice, the report is guaranteed to be controversial.

Thus, I especially appreciate our witnesses being here today.

In studies like this, it is important to understand the ground rules and criteria that the panel used. To some extent, they are as informative as to the conclusions.

For example, ERAB worked from the President's request for 1982, not the budget as Congress appropriated it. I am curious to know ERAB's reaction to the final budget. Although recognizing the need to support long-range research, they did not explicitly take into consideration the need to maintain the R. & D. infrastructure in the national laboratories and industry that has been developed in the last 8 years. Further, the report did not deal with the fundamental question of the status of "energy" as a legitimate national mission.

As we face the 1983 budget and reorganization legislation for DOE, a review of this report is essential to making an informed judgment.

Our witnesses today are Mr. Kenneth Davis, Deputy Secretary of Energy, and Mr. Louis Roddis, Chairman of ERAB.

We are very pleased to have you gentlemen with us this morning.

At this time I would like to insert in the record statements by the chairman of the Subcommittee on Energy Research and Production, and also from the ranking minority member of the Subcommittee on Energy Development Applications, Congressman Fish.

[The prepared statements of Mrs. Bouquard and Mr. Fish follow:]

HON. MARILYN L. BOUQUARD
EDA/ERP JOINT HEARING ON
FEDERAL ENERGY RESEARCH AND DEVELOPMENT PRIORITIES
MARCH 5, 1982

MR. CHAIRMAN, I AM AFRAID THAT THE REPORT IS THE PRODUCT OF AN UNFORTUNATE BUT WELL INTENDED EXERCISE THAT WAS DOOMED TO FAILURE FROM THE START. I CAN FIND SEVERAL RECOMMENDATIONS IDENTIFIED AS FINDINGS OF THE BOARD WHICH I CAN SUPPORT, BUT I HAVE MAJOR DIFFICULTIES WITH MANY OTHERS, AND I AM MOST CONCERNED ABOUT MAJOR ISSUES WHICH ARE IGNORED.

CERTAIN PRIORITIES IN ELECTRIC SUPPLY, SUCH AS NUCLEAR WASTE ISOLATION AND CONVENTIONAL REACTOR SYSTEMS AND SAFETY, ARE RATHER OBVIOUS TO US ON THE COMMITTEE. HOWEVER, I FEEL THAT THE UNWRITTEN AGENDA TO LIVE WITHIN THE PRESIDENT'S UNFORTUNATE FY'82 REQUEST FOR ENERGY R&D AND THE SERIOUS MISESTIMATE OF WHAT ARE THE PRIVATE SECTOR'S LIMITATIONS ARE THE TWIN FACTORS WHICH SANK THIS STUDY.

THE BOARD'S UNFORTUNATE RECOMMENDATION TO SIGNIFICANTLY REDUCE CLINCH RIVER BREEDER FUNDING IS ONLY ONE OF A SERIES OF ITEMS THAT GIVES ME PROBLEMS. THE SUGGESTION OF SMALL REDUCTIONS IN MAGNETIC FUSION WITH NO RECOMMENDATION

AS TO HOW THEY SHOULD BE DISTRIBUTED IS REALLY NOT VERY HELPFUL ADVICE TO THE COMMITTEE WHICH IS VERY SENSITIVE TO INDUSTRY INVOLVEMENT. THE BOARD'S PERCEPTION OF WHAT THE PRIVATE SECTOR WILL DO ON THEIR OWN IN FOSSIL ENERGY AND OTHER TECHNOLOGIES, SUCH AS ELECTRIC ENERGY SYSTEMS, IS AS SHORT-SIGHTED AS THAT OF THE OMB DIRECTOR. ALSO, THE RECOMMENDATION IN TRANSPORTATION CONSERVATION R&D READS AS IF THE AUTOMOTIVE INDUSTRY WERE IN A "ROSY" POSITION FOR R&D INVESTMENT.

I AM PLEASED THAT THE BOARD DID IDENTIFY THE LIGHT WATER BREEDER PROGRAM AS AN AREA FOR SIGNIFICANT REDUCTIONS, BUT I DON'T UNDERSTAND THEIR SIMPLE CONCLUSION THAT MHD FUNDING CAN BE PHASED OUT JUST BECAUSE GAS TURBINES ARE GOING TO BE USED IN COMBINED CYCLE APPLICATIONS.

THE BOARD'S RECOMMENDATION ON THE FEDERAL EFFORT IN SYNTHETIC FUELS RESEARCH SEEMS TO ME UNFORTUNATELY SHORT-SIGHTED. I FOR ONE WOULD HAVE APPRECIATED SOME ADVICE ON WHAT WOULD CONSTITUTE AN APPROPRIATE FEDERAL RESEARCH AND TECHNOLOGY BASE EFFORT. I AM MOST CURIOUS ABOUT WHAT ERAB WOULD SUGGEST WE DO WITH THE FOSSIL ENERGY "GOING OUT OF BUSINESS" BUDGET WE HAVE BEEN PRESENTED WITH FOR FY'83. THE REPORT SIMPLY DOESN'T HELP US ON THAT ISSUE.

I AM AFRAID THAT THE CRITERIA APPROACH AND METHODOLOGY APPEAR ATTRACTIVE ON THE SURFACE, BUT THE APPLICATION OF MUTUALLY CONTRADICTORY REQUIREMENTS SUCH AS, E.G., LONG-TERM, HIGH-RISK ACTIVITY WHICH STILL PROMISES SIGNIFICANT ENERGY PRODUCTION BEFORE THE YEAR 2000, IS SIMPLY NOT WORKABLE.

I AM ALSO CONCERNED ABOUT THE FACT THAT THIS APPROACH IGNORES THE QUALITY OF ENERGY PRODUCED, I.E., WHETHER IT IS STORABLE OR CAN BE READILY DISTRIBUTED, AND CAPABILITY FOR DISPLACEMENT OF OTHER ENERGY SOURCES, E.G., ELECTRICITY WITH HEAT PUMPS SUBSTITUTING FOR HOME HEATING OIL AND NATURAL GAS.

DEPUTY SECRETARY DAVIS AND MR. RODDIS, I RECOGNIZE THAT THIS WAS A GOOD FAITH EFFORT, BUT IT SIMPLY IS WAY OUT OF PHASE WITH RESPECT TO COMMITTEE PRIORITIES. FURTHER, I WOULD STRONGLY SUGGEST THAT THIS TYPE OF EXERCISE SHOULD NOT BE UNDERTAKEN AGAIN WITHOUT SOME DIALOGUE WITH THE COMMITTEE SO THAT WE ARE NOT PRESENTED WITH A REPORT THAT SEEMS TO HAVE BEEN LARGELY DRAFTED IN A VACUUM.

THANK YOU.

OPENING STATEMENT OF THE
HONORABLE HAMILTON FISH, JR. (R-NY)
RANKING MINORITY MEMBER
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
HEARING ON FEDERAL ENERGY RESEARCH AND DEVELOPMENT
PRIORITIES - THE ERAB REPORT
MARCH 5, 1982

THANK YOU, MR. CHAIRMAN. TODAY'S HEARINGS MARK THE BEGINNING OF OUR SUBCOMMITTEE'S CONSIDERATION OF FISCAL YEAR 1983 BUDGET ISSUES. AS WE ALL KNOW, WE WILL FACE MANY IMPORTANT DECISIONS IN THE MONTHS AHEAD. UNDER YOUR GUIDANCE, MR. CHAIRMAN, I AM SURE THAT THE MEMBERS OF THE SUBCOMMITTEE WILL WORK TOGETHER TO ESTABLISH AN EFFECTIVE ENERGY RESEARCH AND DEVELOPMENT PROGRAM FOR OUR NATION. THIS PROGRAM IS ESSENTIAL IF WE ARE TO EVER REACH OUR GOAL OF REDUCING OUR RELIANCE ON FOREIGN SUPPLIES OF OIL.

I WOULD LIKE TO PARTICULARLY COMMEND OUR CHAIRMAN FOR SCHEDULING THESE HEARINGS ON FEDERAL ENERGY RESEARCH AND DEVELOPMENT PRIORITIES AND THE ENERGY RESEARCH ADVISORY BOARD (ERAB) REPORT. THE WORK OF THE DISTINGUISHED GROUP OF SCIENTISTS ON THE ERAB BOARD IS MOST NOTEWORTHY. THEIR RECOMMENDATIONS WILL CERTAINLY BE VALUABLE AS THE SUBCOMMITTEE CARRIES OUT ITS AUTHORIZATION RESPONSIBILITIES THIS YEAR.

THE ERAB BOARD HAS MADE SEVERAL SIGNIFICANT RECOMMENDATIONS, AND I HOPE THAT WE CAN SERIOUSLY CONSIDER SOME OF THEM TODAY. OF EXTREME IMPORTANCE IS THEIR FINDING THAT WE NEED TO PROVIDE MORE BALANCE BETWEEN THE ENERGY SUPPLY AND CONSERVATION PROGRAMS. AS MY FELLOW COLLEAGUES ARE QUITE WELL AWARE, OUR SUBCOMMITTEE HAS SPENT A GREAT DEAL OF TIME IN THE PAST INVESTIGATING THE BENEFITS OF ENERGY CONSERVATION. BASED ON THIS WORK, I STRONGLY SUPPORT THE ERAB PANEL'S CONCLUSION THAT THE OVERALL LEVEL OF FEDERAL SUPPORT FOR CONSERVATION R&D IS TOO LOW, ESPECIALLY IN LIGHT OF THE POTENTIAL OF ENERGY EFFICIENCY IMPROVEMENTS.

ANOTHER NOTEWORTHY FINDING IS THEIR RECOMMENDATION THAT WE SHOULD DELAY THE CONSTRUCTION OF THE CLINCH RIVER BREEDER REACTOR PROJECT UNTIL A FUTURE TIME. FRANKLY, I DO NOT THINK THAT WE CAN AFFORD TO BUILD THIS MASSIVE DEMONSTRATION PROJECT UNDER OUR PRESENT TIGHT BUDGETARY CONSTRAINTS. OUR CURRENT ENERGY SITUATION IS FAR DIFFERENT THAN IT WAS WHEN CONGRESS FIRST AUTHORIZED THIS PROJECT. IT IS NOW MOST IMPORTANT FOR OUR COMMITTEE TO CLOSELY EVALUATE THE MERITS OF THIS PROJECT.

FINALLY, THE ERAB REPORT ALSO POINTS OUT THAT SERIOUS ATTENTION MUST BE PAID TO SEVERAL ENVIRONMENTAL ISSUES. THESE INCLUDE THE ACID RAIN PROBLEM, THE EFFECT OF CARBON DIOXIDE BUILDUP IN THE ATMOSPHERE (THE "GREENHOUSE" PROBLEM), AND OVERALL HEALTH AND ENVIRONMENTAL RESEARCH. THESE ARE CERTAINLY PRESSING ISSUES, AND MUST BE RESOLVED IF WE ARE TO PROVIDE A RATIONAL .

THANK YOU, MR. CHAIRMAN, FOR ALLOWING ME TO MAKE THESE REMARKS. I WOULD LIKE TO WELCOME OUR EMINENTLY QUALIFIED WITNESSES, THE DEPUTY SECRETARY OF ENERGY, DR. W. KENNETH DAVIS, AND THE CHAIRMAN OF THE ERAB BOARD, DR. LOUIS RODDIS. I LOOK FORWARD TO HEARING THEIR TESTIMONY.

Mr. FUQUA. At this time, Mr. Davis, we will be happy to hear from you.

[The biographical sketches of Mr. Davis and Mr. Roddis follow:]

U.S. Department of Energy
Assistant Secretary for
Congressional, Intergovernmental
and Public Affairs
Office of Public Affairs
Washington, D.C. 20585
202/252-5564

BIOGRAPHY

W. KENNETH DAVIS

W. Kenneth Davis was nominated by the President on April 27, 1981, and confirmed by the Senate on May 14, 1981, as Deputy Secretary of the U.S. Department of Energy (DOE). As DOE's second highest ranking executive, he works closely with the Secretary in directing all activities and programs of the Department.

Prior to joining DOE, Mr. Davis was Vice President for Planning and Advanced Development at Bechtel Power Corporation, having joined the Bechtel Group as Vice President in August 1958. A San Francisco-based construction, engineering, and management concern, the Bechtel organization is involved in natural resource, energy-related, and other projects throughout the world. Mr. Davis held various executive positions in Bechtel, primarily in the areas of energy and nuclear development.

Joining the Federal Government in 1954, Mr. Davis served with the U.S. Atomic Energy Commission as Director of Reactor Development. From 1942 to 1954, he held various managerial engineering and development positions in the private sector as well as in academic institutions.

Mr. Davis received a B.S. degree in 1940 and an M.S. degree in 1942. Both degrees were in chemical engineering and awarded by the Massachusetts Institute of Technology (MIT). He served on the faculty of MIT and, before joining the DOE, held the title of Adjunct Professor of Engineering and Applied Science at the University of California at Los Angeles.

Active in numerous professional organizations, Mr. Davis has served also on various Congressional Advisory Committees and Government Task Forces. Currently, he is Immediate Past President of the American Institute of Chemical Engineers and Vice Chairman of the U.S. National Committee of the World Energy Conference. He has served as the Vice President of the National Academy of Engineering. Mr. Davis is the author and co-author of over 200 technical and general articles on energy. Awards which he has received include the Arthur S. Fleming Award in 1956, the AIChE Professional Progress Award in 1958, the AIChE Robert E. Wilson Award in 1969, and the AIF Oliver Townsend Award in 1981.

He is married and has three children.

February 1982

LOUIS H. RODDIS, JR.

BRIEF BIOGRAPHY

Louis H. Roddis, Jr., Consulting Engineer, is a Director of Gould, Inc., Hammermill Paper Company, Research-Cottrell, Inc. and is the former president of Consolidated Edison Company of New York, Inc. He is a member of the Energy Research Advisory Board of the U.S. Department of Energy. He is a consultant to several governmental agencies and private companies in the energy, utility and marine fields.

While an officer in the United States Navy, Mr. Roddis helped develop the first prototype ship propulsion reactor and participated in the design of the USS "NAUTILUS" and other early Navy nuclear projects, serving under Admiral (then Captain) H.G. Rickover, USN, beginning in 1946. He became a member of the Atomic Energy Commission's Division of Reactor Development at its inception in 1949, and was Deputy Director when he left in 1958 to assume the Presidency of Pennsylvania Electric Company, one of the General Public Utilities Corporation's four operating subsidiaries. While with Penelec the company was awarded the industry's coveted Edison Award for extra-high voltage transmission development and construction was begun on the three coal-fired mine-mouth power stations now operated by Penelec. Mr. Roddis joined Consolidated Edison Company of New York, Inc. in 1969 and served as its President from 1969 to 1973. During this time, Consoldiated Edison acquired six large floating gas turbine power plants and became a leader in energy conservation in the electric and gas utility industry in New York State.

Throughout his career in the marine and utility fields, Mr. Roddis has been active in a wide variety of public service, charitable, industrial and trade organizations. He was the only industrial member of the Environmental Panel of the President's Science Advisory Committee, which submitted the report, "Restoring the Quality of our Environment" to President Lyndon B. Johnson in 1965. He was the honor graduate of the United States Naval Academy and is a Captain in the Naval Reserve (Retired). He holds a Master's Degree in Naval Architecture and Marine Engineering from the Massachusetts Institute of Technology and is author of numerous technical papers, including the section on Nuclear (Atomic) Power in Mark's Standard Handbook for Mechanical Engineers. He received the Atomic Energy Commission's Outstanding Service Award in 1957.

He is a member of the National Academy of Engineering and a registered Professional Engineer in South Carolina, New York, Pennsylvania, New Jersey and the District of Columbia, and a Chartered Engineer in the United Kingdom. He is a past Director of the Edison Electric Institute and the American Gas Association and a past President of both the Atomic Industrial Forum and the American Nuclear Society. He is a Fellow of the American Association for the Advancement of Science, the American Society of Mechanical Engineers, The Royal Institution of Naval Architects and the American Nuclear Society and a member of the American Institute of Electrical and Electronic Engineers, the American Society of Heating, Refrigeration and Air Conditioning Engineers, the Society of Naval Engineers, the American Society of Naval Architects and Marine Engineers, the Association of Energy Engineers, the Human Factors Society, and the National Society of Professional Engineers.

Mr. Roddis was born in Charleston, South Carolina in 1918. He and Mrs. Roddis now reside in the historic district of Charleston in a pre-Revolutionary War house that was once the Royal Governor's residence.

Phone 803-723-8319 110 Broad St., Charleston, S.C. 29401

March 1981

STATEMENTS OF W. KENNETH DAVIS, DEPUTY SECRETARY, U.S. DEPARTMENT OF ENERGY, ACCOMPANIED BY LOUIS H. RODDIS, CHAIRMAN, ENERGY RESEARCH ADVISORY BOARD

Mr. DAVIS. Mr. Chairman, members, I am pleased to be with you this morning to discuss the recently published report of the Energy Research Advisory Board regarding Federal energy R. & D. priorities.

I am accompanied by the current Chairman of ERAB, Mr. Louis H. Roddis, Jr., who will also have a statement and be available for questions.

The Energy Research Advisory Board was established to provide the Department with independent advice on energy research and development matters. Since its inception in 1978, ERAB has undertaken several important reviews for the Department. Some of these were specific requests of the Secretary or the Deputy Secretary, while others were generated at the initiative of ERAB itself.

The ERAB study on Federal R. & D. priorities was requested in order to get a perspective on the Department's programs from a broad, diverse group of qualified individuals outside of Government. It was undertaken as part of a continuing analysis of R. & D. issues that had originally been initiated under the previous administration, and a recognition that the earlier efforts did not address the question of priorities and balance between R. & D. programs.

In addition, I asked ERAB to provide the Department with its recommendations for R. & D. efforts in the light of reduced availability of resources. As you know, the role of Government in R. & D. activities has undergone a significant change from a year ago.

As part of our discourse today, and in order to clarify some misconceptions, I would like to comment on our current philosophy on energy R. & D.

First, it is essential to recognize that our energy program is a component of the President's broader domestic economic recovery program; energy policy just cannot be separated from overall economic policy. It is our basic posture that the role of Government is to provide a framework and appropriate climate for private action and initiative. The private sector can and should be free to respond to marketplace realities and be the focus on decisionmaking.

In many areas, the private sector is perfectly capable of handling the development and commercialization of energy technologies. In this context, the Government should then be responsible only for those promising areas where the private sector is unlikely to make the investments that the national interest requires.

This means that our energy R. & D. spending must be selective and targeted and should reflect a consistent underlying rationale; that is, the Federal Government is responsible primarily for longer term research, and the private sector is responsible primarily for development, demonstration, and commercialization of promising technologies.

The Federal program also must reflect the need for fiscal austerity and a reduction in the overall growth of Federal spending. The Department, in the past, had been supporting research and development on a large number of different energy systems. Moreover,

in the context of our current economic situation, it has been necessary to make some hard choices on which programs to continue to pursue and which ones to deemphasize.

Establishing priorities is always difficult and it was with this need in mind that I asked the ERAB to undertake this particular study.

A Federal role can be supported for the longer term, higher risk research that is beyond the time horizon of private companies. Also, basic research is widely recognized to be needed for the Nation's future economic development, but basic research does not command a high priority in private firms, particularly during times of high inflation, high interest rates, and a sluggish economy.

It is also clear that there are other criteria that need to be taken into account in determining the role of the Federal Government in supporting research and development.

For example, purely economic or philosophical criteria do not reflect other factors such as protecting the environment and human health, or the existence of overriding national goals such as national security. In addition, the uranium enrichment and waste management segments of the nuclear fuel cycle traditionally have been the sole responsibility of the Federal Government.

Also, as you know, the Federal Government is supporting research and development on the two most promising long-term technologies for large-scale electric generation, breeder reactors, and magnetic fusion. These are programs with high development costs requiring laboratory experimentation and full-scale test facilities that are beyond the scope or financial capability of any single industry, utility, or even a consortia of utilities.

Once these technologies are ready for commercialization, however, the role of the Federal Government will be substantially diminished.

The Department's role in energy research and development thus encompasses a broad spectrum of different applications and roles. There is not a straightforward set of conditions by which one can make easy decisions. Many factors need to be taken into consideration in making judgments.

For example, where programs are curtailed, we want to insure that an appropriate transition to private initiative is encouraged; where Federal programs are continued, we want to insure coupling and technology transfer to private firms.

Where programs are terminated, we have determined that these efforts are not appropriate for Federal support. And, if there is an economic potential, private industry will support.

As changes take place, we intend to maintain the Nation's core science capabilities in the national laboratories, industries, and the universities. A follow-on ERAB panel is examining the future role of the national laboratories, at my request, and I view cooperation between universities, national laboratories, and industry as being a key element in an effective energy R. & D. program.

We must continue to make the long-range investments in basic sciences to provide the knowledge that undergirds our future. These investments provide the basis for the creativity and innovation that are needed for our national progress.

The Department looks forward to continued advice and assistance from the science and engineering community in planning and implementing the DOE R. & D. program, including the Energy Research Advisory Board and various other panels and study groups. This kind of information can go a long way toward improving our ability to make wise judgments and more effectively serve the national interest through our R. & D. programs.

There are many factors to be weighed and men of good will can, and do, differ in making such judgments. Certainly, the lively debates that have taken place here on Capitol Hill over our programs serve to provide the point. Nevertheless, we simply cannot afford to explore every idea that may have some potential; we must choose the best and leave the rest. To do this fairly, we must be systematic as well as selective.

My purpose in asking the ERAB to address priorities among our programs was to try to improve the quality of our debates and to insure that viewpoints from outside the Government would get a full hearing.

As you know, advisory committees such as the ERAB are required by law to reflect a balance of different perspectives and their meetings are open to the public. Due to the required openness of the process, ERAB could not be privy to the specifics of many of our internal discussions during the period of their study.

In addition, the results of the ERAB panel were not available to the Department to consider in formulating the fiscal year 1983 budget.

I would like at this point to publicly thank the ERAB members for giving their time in seeking to provide advice to the Department. Many very busy and capable people took time to give us the benefit of their thinking. Setting priorities and agreeing on them is always difficult, particularly when overall funding is going down.

I think it would be presumptious to expect that the study would agree totally with present DOE policies. Indeed, in accordance with the Federal Advisory Committee Act, the advice and recommendations of an advisory committee must be the result of the committee's independent judgment, and not be inappropriately influenced by the appointing authority or by any special interest.

I expect and look forward to continued assistance from ERAB in order to focus more precisely on the Federal versus private sector roles in the various energy technology areas. I might add that the Department receives input in its programs and priorities from a variety of sources, including other advisory committees, industrial organizations, the National Academy of Sciences, and others.

We try to take into account a whole variety of valid views from different perspectives in formulating our research and development programs.

Mr. Chairman, this concludes my testimony. Mr. Roddis will now provide you with his statement.

[The prepared statement of Mr. Davis follows:]

Statement of W. Kenneth Davis, Before the House Science and Technology Committee, March 5, 1982

Mr. Chairman:

I am pleased to be with you this morning to discuss the recently published report of the Energy Research Advisory Board regarding Federal energy R&D priorities. I am accompanied by the current Chairman of ERAB, Mr. Louis H. Roddis, Jr., who will also have a statement and be available for questions.

The Energy Research Advisory Board was established to provide the Department with independent advice on energy research and development matters. Since its inception in 1978, ERAB has undertaken several important reviews for the Department. Some of these were specific requests of the Secretary or the Deputy Secretary, while others were generated at the initiative of ERAB itself.

The ERAB study on Federal R&D priorities was requested in order to get a perspective on the Department's programs from a broad, diverse group of qualified individuals outside of government. It was undertaken as part of a continuing analysis of R&D issues that had originally been initiated under the previous Administration, and a recognition that the earlier efforts did not address the question of priorities and balance between R&D programs. In addition, I asked ERAB to provide the Department with its recommendations for R&D efforts in the light of reduced

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availability of resources. As you know, the role of government in R&D activities has undergone a significant change from a year ago.

As part of our discourse today, and in order to clarify some misconceptions, I would like to comment on our current philosophy on energy R&D. First, it is essential to recognize that our energy program is a component of the President's broader domestic economic recovery program; energy policy just cannot be separated from overall economic policy. It is our basic posture that the role of government is to provide a framework, and appropriate "climate" for private action and initiative. The private sector can, and should, be free to respond to marketplace realities and be the focus of decisionmaking. In many areas, the private sector is perfectly capable of handling the development and commercialization of energy technologies. In this context, the government should then be responsible only for those promising areas where the private sector is unlikely to make the investments that the national interest requires. This means that our energy R&D spending must be selective and targeted, and should reflect a consistent underlying rationale; that is, the Federal Government is responsible primarily for longer term research, and the private sector is responsible primarily for development, demonstration and commercialization of promising technologies.

The Federal program also must reflect the need for fiscal austerity and a reduction in the overall growth of Federal spending. The Department, in the past, had been supporting research and development on a large number of different energy systems. Moreover, in the context of our current economic situation, it has been necessary to make some hard choices on which programs to continue to pursue and which ones to deemphasize. Establishing priorities is always difficult and it was with this need in mind that I asked the ERAB to undertake this particular study.

A Federal role can be supported for the longer term, higher risk research that is beyond the time horizon of private companies. Also, basic research is widely recognized to be needed for the Nation's future economic development, but basic research does not command a high priority in private firms, particularly during times of high inflation, high interest rates, and a sluggish economy. It is also clear that there are other criteria that need to be taken into account in determining the role of the Federal Government in supporting research and development. For example, purely economic or philosophical criteria do not reflect other factors such as protecting the environment and human health, or the existence of overriding national goals such as national security. In addition, the uranium enrichment and waste management segments of the nuclear fuel cycle traditionally have been the sole responsibility of the Federal Government.

Also, as you know, the Federal Government is supporting research and development on the two most promising long-term technologies for large scale electric generation -- breeder reactors and magnetic fusion. These are programs with high development costs requiring laboratory experimentation and full-scale test facilities that are beyond the scope or financial capability of any single industry, utility or even a consortia of utilities. Once these technologies are ready for commercialization, however, the role of the Federal Government will be substantially diminished.

The Department's role in energy research and development thus encompasses a broad spectrum of different applications and roles. There is not a straightforward set of conditions by which one can make easy decisions. Many factors need to be taken into consideration in making judgments. For example,

- Where programs are curtailed, we want to ensure that an appropriate transition to private initiative is encouraged; where Federal programs are continued, we want to ensure coupling and technology transfer to private firms.

- Where programs are terminated, we have determined that these efforts are not appropriate for Federal support. And, if there is an economic potential, private industry will support.
- As changes take place, we intend to maintain the Nation's core science capabilities in the national laboratories, industries and the universities. A follow-on ERAB panel is examining the future role of the national laboratories at my request, and I view cooperation between universities, national laboratories and industry as being a key element in an effective energy R&D program.
- We must continue to make the long-range investments in basic sciences to provide the knowledge that undergirds our future. These investments provide the basis for the creativity and innovation that are needed for our national progress.

The Department looks forward to continued advice and assistance from the science and engineering community in planning and implementing the DOE R&D program -- including the Energy Research Advisory Board and various other panels and study groups. This kind of information can go a long way toward improving our ability to make wise judgments and more effectively serve the national interest through our R&D programs.

There are many factors to be weighed and men of goodwill can, and do, differ in making such judgments. Certainly the

lively debates that have taken place here on Capitol Hill over our programs serve to prove the point. Nevertheless, we simply cannot afford to explore every idea that may have some potential; we must choose the best and leave the rest. To do this fairly, we must be systematic as well as selective.

My purpose in asking the ERAB to address priorities among our programs was to try to improve the quality of our debates and to ensure that viewpoints from outside the government would get a full hearing. As you know, advisory committees such as the ERAB are required by law to reflect a balance of different perspectives and their meetings are open to the public. Due to the required openness of the process, ERAB could not be privy to the specifics of many of our internal discussions during the period of their study. In addition, the results of the ERAB panel were not available to the Department to consider in formulating the FY 1983 budget.

I would like at this point to publicly thank the ERAB members for giving their time in seeking to provide advice to the Department. Many very busy and capable people took time to give us the benefit of their thinking. Setting priorities and

agreeing on them is always difficult, particularly when overall funding is going down. I think it would be presumptious to expect that the study would agree totally with present DOE policies. Indeed, in accordance with the Federal Advisory Committee Act, the advice and recommendations of an advisory committee must be the result of the committee's independent judgment, and not be inappropriately influenced by the appointing authority or by any special interest.

I expect and look forward to continued assistance from ERAB in order to focus more precisely on the Federal versus private sector roles in the various energy technology areas. I might add that the Department receives input in its programs and priorities from a variety of sources, including other advisory committees, industrial organizations, and the National Academy of Sciences. We try to take into account a whole variety of valid views from different perspectives in formulating our research and development programs.

Mr. Chairman, this concludes my testimony. Mr. Roddis will now provide you with his statement.

Mr. FUQUA. Thank you, Mr. Davis.

Mr. Roddis, we are pleased to hear from you at this time.

Mr. RODDIS. I have a prepared statement which I would like to introduce in the record and brief it to save some time.

Mr. FUQUA. Without objection, we will make the prepared statement in its entirety a part of the record, and if you wish to summarize, we would be pleased.

Mr. RODDIS. Thank you; I will do so.

ERAB is an independent advisory committee established by DOE in 1978.

Members are appointed by the Secretary, and members are distinguished private citizens drawn from industry, universities, public interest groups, and State and local governments.

Members serve on an entirely voluntary basis and are not special Government employees.

The rules for closure of our meetings are much more restricted under the DOE Act than under the normal FACA Act rules. So all of our deliberations are in public, and we have no access to public figures until they are released publicly.

The Board's role is advisory only and has no direct voice in policymaking, and neither ERAB nor myself represent the views of the Department or the administration in any way.

When I speak about this report, or any other matter which ERAB has been deliberating and arrived at conclusions, I am formally speaking as a spokesman for ERAB. The entire 21-membership list is listed in the record.

The R. & D. priorities report actually builds on a 2-year effort of the R. & D. panel, chaired by John Foster. In the first phase of this effort, the panel was asked by DOE to review the adequacy of the energy technology base. This resulted in a report titled "R. & D. Needs in the Department of Energy," submitted in September 1980.

However, at that time, the Board noted that this effort did not adequately address the question of priorities and balance between R. & D. programs given the increasingly stringent budgets that DOE would be facing in the future.

When ERAB was asked to again look at Energy R. & D. priorities in the light of the President's 1982 budget, which was at that time in the public domain, we decided to act as a committee of the whole with all ERAB members serving on the R. & D. panel. This saved the time of putting together other subpanels with additional outside membership as was done in 1980.

This also allowed ERAB to produce a final report in one step. In our normal process a panel submits a draft report which ERAB either adopts as its own or modifies for adoption.

In the 1981 phase of this effort, the panel explored alternative methods for assessing R. & D. priorities including the use of various energy models. Most of these methods, however, were found to be mismatched to the task at hand. A simple ranking method was finally adopted that took into account the limited time available, incompleteness and unreliability of data, the judgmental nature of the decisions facing the Department, and pitfalls of trying to foretell the future.

The next phase, started in August of 1981, implemented the chosen method which involved:

(A) Review and classification of R. & D. programs by near- and long-term impact and by electric, fuels, conservation, and technology base contributions.

(B) Careful definition and weighting of the ranking criteria. Different sets of criteria were needed to evaluate programs directed at energy technology versus more basic research:

Energy Program Criteria: (1) Technological potential; (2) urgency; (3) economic potential; (4) benefit/cost; (5) energy security; (6) safety, health and environment; and (7) Federal R.D. & D. role.

Science and technology base program criteria: (1) Scientific potential; (2) inventive potential; (3) mission impact; (4) urgency; and (5) Federal R.D. & D. role.

The full definitions of the criteria are provided in appendix C of the report.

(C) Each member of ERAB then individually ranked each R. & D. program by each of these criteria using a common set of guidelines and questionnaires.

(D) The results were then compiled numerically and analyzed by the staff and provided to the Board as an initial rank ordering of priorities. About three-quarters were essentially unanimous, and we spent most of our time concentrating on the other one-quarter.

The final phase involved extensive debate and consequent refinement of these rankings and preparation of the Board's final report. Of the 4 days of public meetings, at least three-quarters of that time was spent on the one-quarter in which there was any difference.

We resolved all of these differences except two, which I will discuss.

To quote the Panel's chairman:

> I believe that the evaluation methodology worked quite well. It provided assurance that the key criteria were explicitly considered, and this helped us identify quickly the sources of agreement and disagreement. The second stage of the process provided for resolution of the areas of disagreement. Where necessary, members of the Board voted to arrive at final recommendations.

Where agreement could not be reached, minority views were included in the final report. Given the complexity of the task, it is remarkable that the Board achieved a high level of consensus except on two issues.

We were in agreement on 47 of the 49 program categories in the energy R. & D. budget, unanimously by a Board with a wide variety of backgrounds. The two areas of disagreement were the Clinch River Breeder Reactor, not the base breeder program as a whole, which was unanimously supported, and the electric and hybrid auto.

Our end goal was to prepare a collective ERAB assessment of how such factors should influence the priority and balance of funding for each of some 49 program areas currently funded by the Department of Energy. The value judgments made by the members of ERAB as a group had to include a very broad spectrum of expertise.

Our approach brought this collective judgment to bear on the problem through a structured application of formulated criteria, al-

lowing us to make what we feel is a very useful balanced judgment on R. & D. priorities. To my knowledge, this is the first time that a structured framework for evaluating priorities over such a broad spectrum of science, technology, and engineering R. & D. activites has been attempted.

There is thorough documentation of the report and the working papers of the panel, if you are interested.

Our conclusions are organized around four major energy R. & D. categories. The first category, the energy science and technology base, embodies the fundamental research and technology which is the underpinning for innovative new ideas in conservation and energy supply.

The second category is those energy supply R. & D. programs which have as their primary focus the production of electric energy.

The third category is comprised of R. & D. on all other forms of fuel supplies for various energy end uses.

The fourth category is those R. & D. programs which contribute to more efficient utilization and conservation of our scarce energy resources.

Overall, we concluded that: "The Board believes that if its recommendations are implemented, a net reduction in DOE's budget will result."

Science and technology base, I should note that programs in this area in general were ranked higher in priority than the other categories and that this area was one of significance with regard to a strong continued Federal role. The back page contains a listing of all 49 categories and their rankings.

Science and technology base programs of the DOE comprise over a billion dollars or 28 percent of the DOE's fiscal year 1982 President's budget. Two key areas are of particular importance in the view of ERAB. The first is research on CO_2 accumulation mechanisms and climate effects. The second is research on the causes, effects, and control of acid rain. Numerous other areas of science and technology base are rated as high priorities for Federal research and are shown in table 1.

In the area of electric-related supply technology, electric-related supply programs constitute over $2 billion, or 55 percent of the total DOE budget. The ERAB concluded that the highest priority should be given to the support of nuclear waste disposal programs, conventional reactor systems and safety, the liquid metal fast breeder reactor base programs, and uranium enrichment R. & D.

At the same time, ERAB recommended that some electric energy supply R. & D. programs could be reduced, including small reductions for magnetic fusion, and significant reductions in the Clinch River Breeder, the light water breeder, electricity transmission, and high temperature geothermal programs.

I would add that the committee was divided, with a strong dissenting opinion reported, in which I concurred, regarding the recommendation to reduce the Clinch River Breeder project.

Other reductions in funding included the recommendation for the phase-out of hydropower and MHD programs. The Board also noted that the 55 percent fraction of the DOE's funding budget is

substantially in excess of electric contributions to current and projected future energy supply.

In the area of fuel supply technology, the fuel supply technologies of DOE report approximately 9 percent of the total fiscal year 1982 President's budget, or approximately $360 million. This sector of energy supply is not as highly regulated as the electric utility industry and has historically developed these supplies with private resources.

In general, ERAB concluded that energy technologies such as enhanced gas and oil recovery can have an early impact in the marketplace. But that the Federal role is significantly less since private industry should develop these sources.

The Board recommended that these programs could thus be reduced and that the major Federal effort in synthetic fuel research and development be directed at innovative concepts and small, pilot-plant scale. ERAB also recommended that fuel supply R. & D. funding be directed at producing liquids and gases from biomass.

They concluded that alcohol production R. & D. is at an appropriate level in the President's budget. In recognizing environmental concerns due to fossil fuels development, ERAB suggested that parts of the advanced research and environmental control technology programs concerned with control of SO_x and NO_x and particle emissions be increased and strengthened.

The energy conservation and end-use technology programs comprise 8 percent of the DOE fiscal year 1982 budget or approximately $294 million. ERAB concluded that the R. & D. funding was too low compared to the supply technologies and recommended that a better balance with other programs needs to be achieved by increasing funds allocated to buildings and community systems in industrial conservation.

The Board felt that implementation of these recommendations could lead to a more judicial balance of the DOE's R. & D. budget and to a reduction in the total budget compared to fiscal year 1981.

With regard to Federal role, ERAB agrees with the administration's policy of greater reliance on the private sector whenever possible. We agree with the restoration of a free market in petroleum. ERAB believes that much, perhaps most, of new energy supplies and greater efficiency in energy use will in fact be achieved by higher energy prices.

But ERAB is also concerned that some energy R. & D. of great potential significance for the achievement of the Nation's energy goals will fall between Federal and industry responsibilities. The new policy recognizes that private industry cannot be expected to do basic energy research or projects of a long-term, higher-risk character. But there are other circumstances in which it would be unrealistic to expect timely and effective assumption by industry of R. & D. responsibilities abdicated by the Government, however worthy the projects involved, and despite the provision of new generous tax incentives.

A little over half our primary energy finds its way to consumers through the electric and gas utilities, and the utilities are regulated, price-controlled industries, selling their products not at free market prices, but at controlled prices well below replacement cost. Both these regulated industries have relatively weak incentives to

spend much on R. & D. In addition, some energy-related industries are too fragmented to organize and finance a strong R. & D. response to market signals, the building industry being a prime example here.

ERAB in its evalutions of programs took the new policies and guidelines relative to the Federal role very seriously, but ERAB has made exceptions where there is reasonable certainty that timely and adequate response by industry and commerce is an unrealistic assumption, and that continued Federal research support is therefore still required, at least for a time.

Chairman Fuqua also asked me to comment on the strengths and limitations of the report. Most of these are imbedded in the advisory process itself or the adequacy of the knowledge base from which we must all form our judgments about energy technology.

In particular, we had some difficulty with the reliability, objectivity, and comparability of technical assessment data on advanced energy technology. Independent systems analyses and technical assessment capabilities have not been adequately developed and the quantity of paper studies tends to outweigh the quality. The Board's efforts would have been aided by similar in-house work.

We believe the lasting contribution of the report is not the individual rankings since these may change as new data becomes available and many people will take issue with our judgments, but rather in the overall perspectives and concepts advanced about R. & D. priorities and Federal role.

More importantly, there are a number of strengths and limitations in the advisory process itself. As you know, Federal advisory committee regulations require that the membership represent the balance of viewpoints and that meetings are open to the public.

The Board's membership, listed in the report, does include a wide spectrum of views which not only insures many spirited debates but also independent advice that is not always in concert with the administration. In accordance with the Federal Advisory Committee Act [FACA] rules a very real effort has been made to include the required variety of viewpoints in ERAB.

The strength of this process is in providing the independent judgment of a diverse group of outside experts. On the other hand, the Board does not have the benefit of timely access to all budgetary and technical information nor internal deliberations of the Department on R. & D. policy before the fact. Thus, the limitation of the advisory process is in keeping pace with policy developments in order to provide timely and relevant advice.

As I mentioned before, the DOE Act only allows our meetings to be closed for two of the nine Federal Advisory Committee Act-Freedom of Information Act provisions, so we cannot receive internal information during the budget process. Of course, the Board's role is advisory only and has no direct voice in policymaking.

In this regard, I draw your attention to a recent report of the Charles F. Kettering Foundation, titled "Federal Advisory Committees: An Important Frustration," which raises important issues regarding the integrity and utility of the Advisory Committee process. This may be of some concern to this committee because of the special role of science and technology advice in providing technical information and judgment to Government.

I would also call your attention to a 1978 report of the National Research Council of the National Academy of Sciences: "Private Sector Participation in Federal energy R.D. & D. Planning." The recommendations of that report are as sound as when they were made in 1978.

That report explored in some detail the complexities and constraints that inhibit the Federal advisory committee process and recommended the establishment of a formal Advisory board reporting to the Secretary of Energy. Three members of the present ERAB, including myself, served on the NAS/NRC Committee.

Copies of these two reports and the ERAB R. & D. Priorities Report are hereby submitted to the record.[1]

This concludes my summary of our conclusion. I would be happy to answer any questions you may have regarding our report.

[The prepared statement of Mr. Roddis follows:]

TESTIMONY OF

LOUIS H. RODDIS, JR.
CHAIRMAN
ENERGY RESEARCH ADVISORY BOARD

I. INTRODUCTION

MR. CHAIRMAN AND MEMBERS OF THE COMMITTEES--

THANK YOU FOR THIS OPPORTUNITY TO DISCUSS WITH YOU THE ENERGY RESEARCH ADVISORY BOARD'S RECENT REPORT TO THE DEPARTMENT OF ENERGY ON FEDERAL ENERGY R&D PRIORITIES. AS YOU KNOW, THE ERAB IS AN INDEPENDENT ADVISORY BOARD TO THE SECRETARY OF ENERGY. IT IS THE HIGHEST LEVEL SCIENCE AND TECHNOLOGY ADVISORY GROUP TO THE DEPARTMENT, SIMILAR TO THE OLD GENERAL ADVISORY COMMITTEE TO THE ATOMIC ENERGY COMMISSION. OVER THE COURSE OF THE LAST THREE YEARS, ERAB HAS BEEN CONCERNED WITH VARIOUS R&D REVIEWS OF NUMEROUS TECHNOLOGICAL AND SCIENTIFIC PROGRAMS OF THE DEPARTMENT OF ENERGY, INCLUDING REVIEWS OF SUCH TECHNOLOGIES AS MAGNETIC FUSION ENERGY, ADVANCED ISOTOPE SEPARATION, BIOMASS ENERGY, AND MANY OTHERS.

ONE OF OUR MOST UNUSUAL AND DIFFICULT UNDERTAKINGS HAS BEEN THE REVIEW OF ENERGY R&D PRIORITIES UNDERTAKEN BY THE R&D PANEL AT THE REQUEST OF THE DEPUTY SECRETARY. THE PANEL WAS CHAIRED BY JOHN FOSTER OF TRW AND BILL MCCORMICK OF AMERICAN NATURAL RESOURCES.

THE REPORT I WILL DISCUSS WITH YOU TODAY IS THE RESULT OF THIS PANEL'S EFFORT, WHICH INCLUDED THE EFFORTS OF ALL ERAB MEMBERS. IN THIS REPORT WE HAVE TRIED TO ASSURE THAT THE CONTEXT OF OUR ADVICE ON R&D PRIORITIES, PARTICULARLY WITH RESPECT TO THE FEDERAL ROLE, IS CONSISTENT WITH THE NEW ADMINISTRATION'S GOALS, WHILE AT THE SAME TIME MAINTAINING THE MOST EFFECTIVE USE OF INCREASINGLY LIMITED R&D RESOURCES. OUR CHIEF CONCERN WAS THE ROLE OF

FEDERALLY-SPONSORED R&D, AS OPPOSED TO PRIVATELY-SPONSORED ENERGY R&D, IN PROVIDING NEW ENERGY SUPPLIES AND CONSERVATION TECHNOLOGIES TO MEET THE ENERGY REQUIREMENTS OF THE NATION. THE PRIMARY TASK OF THE R&D PANEL WAS TO PROVIDE ADVICE TO THE SECRETARY OF ENERGY CONCERNING THE MOST EFFICIENT USE OF FEDERAL R&D FUNDS BOTH IN TERMS OF PRIORITIES AND BALANCE OF BUDGET BETWEEN R&D PROGRAMS IN AN ENVIRONMENT OF DECREASING FEDERAL BUDGETS.

FIRST, FOR THOSE MEMBERS UNFAMILIAR WITH THE BOARD, I SHOULD POINT OUT THAT ERAB IS AN INDEPENDENT ADVISORY COMMITTEE ESTABLISHED BY DOE IN 1978 AND IS CHARTERED UNDER THE FEDERAL ADVISORY COMMITTEE ACT.

- IT IS THE HIGHEST LEVEL SCIENCE AND TECHNOLOGY ADVISORY COMMITTEE IN DOE, REPORTING TO THE SECRETARY AND DEPUTY SECRETARY;
- MEMBERS ARE APPOINTED BY THE SECRETARY;
- MEMBERS ARE DISTINGUISHED PRIVATE CITIZENS DRAWN FROM INDUSTRY, UNIVERSITIES, PUBLIC INTEREST GROUPS, AND STATE AND LOCAL GOVERNMENT;
- MEMBERS SERVE ON A VOLUNTARY BASIS AND ARE NOT SPECIAL GOVERNMENT EMPLOYEES;
- THE RULES FOR CLOSURE OF MEETINGS ARE MUCH MORE RESTRICTED UNDER THE DOE ACT THAN THE NORMAL FEDERAL ADVISORY COMMITTEE ACT (FACA) RULES, SO OUR DELIBERATIONS ARE IN PUBLIC AND WE HAVE NO ACCESS TO BUDGET FIGURES UNTIL THESE ARE RELEASED PUBLICLY;
- THE BOARD'S ROLE IS <u>ADVISORY ONLY</u> AND HAS NO DIRECT VOICE IN POLICY MAKING;
- CONVERSELY, I MUST ALSO POINT OUT THAT NEITHER THE ERAB NOR MYSELF REPRESENT THE VIEWS OF THE DEPARTMENT OR THE ADMINISTRATION;
- WHEN SPEAKING ABOUT THE R&D PRIORITIES REPORT, I AM SPEAKING FOR ERAB.

II. APPROACH AND METHODOLOGY

THE R&D PRIORITIES REPORT ACTUALLY BUILDS ON A TWO-YEAR EFFORT OF THE R&D PANEL CHAIRED BY JOHN FOSTER. IN THE FIRST PHASE OF THIS EFFORT, THE PANEL WAS ASKED BY DOE TO REVIEW THE ADEQUACY OF THE ENERGY TECHNOLOGY BASE. THIS RESULTED IN A REPORT TITLED R&D NEEDS IN THE DEPARTMENT OF ENERGY, SUBMITTED IN SEPTEMBER OF 1980. HOWEVER, THE BOARD NOTED THAT THIS EFFORT DID NOT ADEQUATELY ADDRESS THE QUESTION OF PRIORITIES AND BALANCE BETWEEN R&D PROGRAMS GIVEN THE INCREASINGLY STRINGENT BUDGETS THAT DOE WOULD BE FACING IN THE FUTURE.

WHEN ERAB WAS ASKED TO AGAIN LOOK AT ENERGY R&D PRIORITIES IN THE LIGHT OF THE PRESIDENT'S 1982 BUDGET, WE DECIDED TO ACT AS A COMMITTEE OF THE WHOLE WITH ALL ERAB MEMBERS SERVING ON THE R&D PANEL. THIS SAVED THE TIME OF PUTTING TOGETHER OTHER SUBPANELS WITH ADDITIONAL OUTSIDE MEMBERSHIP AS WAS DONE IN 1980. THIS ALSO ALLOWED ERAB TO PRODUCE A FINAL REPORT IN ONE STEP. IN OUR NORMAL PROCESS A PANEL SUBMITS A DRAFT REPORT WHICH ERAB EITHER ADOPTS AS ITS OWN OR MODIFIES FOR ADOPTION.

IN THE 1981 PHASE OF THIS EFFORT, THE PANEL EXPLORED ALTERNATIVE METHODS FOR ASSESSING R&D PRIORITIES INCLUDING THE USE OF VARIOUS ENERGY MODELS. MOST OF THESE METHODS, HOWEVER, WERE FOUND TO BE MISMATCHED TO THE TASK AT HAND. A SIMPLE RANKING METHOD WAS FINALLY ADOPTED THAT TOOK INTO ACCOUNT THE LIMITED TIME AVAILABLE, INCOMPLETENESS AND UNRELIABILITY OF DATA, THE JUDGEMENTAL NATURE OF THE DECISIONS FACING THE DEPARTMENT, AND PITFALLS OF TRYING TO FORETELL THE FUTURE.

THE NEXT PHASE, STARTED IN AUGUST OF 1981, IMPLEMENTED THE CHOSEN METHOD WHICH INVOLVED:

A. REVIEW AND CLASSIFICATION OF R&D PROGRAMS BY NEAR- AND LONG-TERM IMPACT AND BY ELECTRIC, FUELS, CONSERVATION, AND TECHNOLOGY BASE CONTRIBUTIONS.

B. CAREFUL DEFINITION AND WEIGHTING OF THE RANKING CRITERIA. DIFFERENT SETS OF CRITERIA WERE NEEDED TO EVALUATE PROGRAMS DIRECTED AT ENERGY TECHNOLOGY VERSUS MORE BASIC RESEARCH:

ENERGY PROGRAM CRITERIA

1. TECHNOLOGICAL POTENTIAL
2. URGENCY
3. ECONOMIC POTENTIAL
4. BENEFIT/COST
5. ENERGY SECURITY
6. SAFETY, HEALTH AND ENVIRONMENT
7. FEDERAL RD&D ROLE

SCIENCE AND TECHNOLOGY BASE PROGRAM CRITERIA

1. SCIENTIFIC POTENTIAL
2. INVENTIVE POTENTIAL
3. MISSION IMPACT
4. URGENCY
5. FEDERAL RD&D ROLE

THE FULL DEFINITIONS OF THE CRITERIA ARE PROVIDED IN APPENDIX C OF THE REPORT.

C. EACH MEMBER OF ERAB THEN INDIVIDUALLY RANKED EACH R&D PROGRAM BY EACH OF THESE CRITERIA USING A COMMON SET OF GUIDELINES AND QUESTIONNAIRES.

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D. THE RESULTS WERE THEN COMPILED NUMERICALLY AND ANALYZED BY THE STAFF AND PROVIDED TO THE BOARD AS AN INITIAL RANK ORDERING OF PRIORITIES.

THE FINAL PHASE, INVOLVED EXTENSIVE DEBATE AND CONSEQUENT REFINEMENT OF THESE RANKINGS AND PREPARATION OF THE BOARD'S FINAL REPORT. THE RANKING METHOD USED PROVIDED FOR A SYSTEMATIC, INTERNALLY CONSISTENT AND THOROUGH DEBATE OF THE ISSUES. TO QUOTE THE PANEL'S CHAIRMAN:

> "I BELIEVE THAT THE EVALUATION METHODOLOGY WORKED QUITE WELL. IT PROVIDED ASSURANCE THAT THE KEY CRITERIA WERE EXPLICITLY CONSIDERED, AND THIS HELPED US IDENTIFY QUICKLY THE SOURCES OF AGREEMENT AND DISAGREEMENT. THE SECOND STAGE OF THE PROCESS PROVIDED FOR RESOLUTION OF THE AREAS OF DISAGREEMENT. WHERE NECESSARY, MEMBERS OF THE BOARD VOTED TO ARRIVE AT FINAL RECOMMENDATIONS."

WHERE AGREEMENT COULD NOT BE REACHED, MINORITY VIEWS WERE INCLUDED IN THE FINAL REPORT. GIVEN THE COMPLEXITY OF THE TASK, IT IS REMARKABLE THAT THE BOARD ACHIEVED A HIGH LEVEL OF CONSENSUS EXCEPT ON TWO ISSUES.

WE WERE IN AGREEMENT ON 47 OUT OF THE 49 PROGRAM CATEGORIES IN THE ENERGY R&D BUDGET. THIS STRIKES ME AS EXCELLENT AGREEMENT FROM A BOARD WITH SUCH A WIDE VARIETY OF BACKGROUNDS. THE TWO AREAS OF DISAGREEMENT WERE THE CLINCH RIVER BREEDER REACTOR (NOT THE BASE BREEDER PROGRAM AS A WHOLE WHICH WAS UNANIMOUSLY SUPPORTED) AND THE ELECTRIC AND HYBRID AUTO.

IN SHORT, ERAB HAD TO COME TO GRIPS WITH THE RELATIVE IMPORTANCE OF TECHNICAL RISK, ECONOMIC POTENTIAL, POTENTIAL CONTRIBUTION TO

ENERGY SECURITY, URGENCY, HEALTH SAFETY AND ENVIRONMENT FACTORS, AND THE PROPER ROLE OF FEDERAL R&D AS OPPOSED TO PRIVATELY FINANCED R&D. OUR END GOAL WAS TO PREPARE A COLLECTIVE ERAB ASSESSMENT OF HOW SUCH FACTORS SHOULD INFLUENCE THE PRIORITY AND BALANCE OF FUNDING FOR EACH OF SOME 49 PROGRAM AREAS CURRENTLY FUNDED BY THE DEPARTMENT OF ENERGY. THE VALUE JUDGEMENTS MADE BY THE MEMBERS OF ERAB AS A GROUP HAD TO INCLUDE A VERY BROAD SPECTRUM OF EXPERTISE. OUR APPROACH BROUGHT THIS COLLECTIVE JUDGEMENT TO BEAR ON THE PROBLEM THROUGH A STRUCTURED APPLICATION OF CAREFULLY FORMULATED CRITERIA, ALLOWING US TO MAKE WHAT, WE FEEL, IS A VERY USEFUL BALANCED JUDGEMENT ON R&D PRIORITIES. TO MY KNOWLEDGE, THIS IS THE FIRST TIME THAT A STRUCTURED FRAMEWORK FOR EVALUATING PRIORITIES OVER SUCH A BROAD SPECTRUM OF SCIENCE, TECHNOLOGY, AND ENGINEERING R&D ACTIVITIES HAS BEEN ATTEMPTED.*

III. FINDINGS AND RECOMMENDATIONS

INCLUDED WITH MY TESTIMONY IS A COPY OF THE DETAILED ERAB REPORT. OUR CONCLUSIONS ARE ORGANIZED AROUND FOUR MAJOR ENERGY R&D CATEGORIES. THE FIRST CATEGORY, THE ENERGY SCIENCE AND TECHNOLOGY BASE, EMBODIES THE FUNDAMENTAL RESEARCH AND TECHNOLOGY WHICH IS THE UNDERPINNING FOR INNOVATIVE NEW IDEAS IN CONSERVATION AND ENERGY SUPPLY. THE SECOND CATEGORY IS THOSE ENERGY SUPPLY R&D PROGRAMS WHICH HAVE AS THEIR PRIMARY FOCUS THE PRODUCTION OF ELECTRIC ENERGY. THE THIRD CATEGORY IS COMPRISED OF R&D ON ALL OTHER FORMS OF FUEL

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* NOTE: THE METHODS USED ARE MORE THOROUGHLY DOCUMENTED IN THE REPORT AND WORKING PAPERS OF THE PANEL, IF THESE ARE OF INTEREST.

SUPPLIES FOR VARIOUS ENERGY END USES. THE FOURTH CATEGORY IS THOSE R&D PROGRAMS WHICH CONTRIBUTE TO MORE EFFICIENT UTILIZATION AND CONSERVATION OF OUR SCARCE ENERGY RESOURCES.

OVERALL, WE CONCLUDED THAT:

"THE BOARD BELIEVES THAT IF ITS RECOMMENDATIONS ARE IMPLEMENTED, A NET REDUCTION IN DOE'S BUDGET WILL RESULT."

A. Science and Technology Base

BEGINNING FIRST WITH OUR RECOMMENDATIONS IN THE AREA OF SCIENCE AND TECHNOLOGY BASE, I WOULD NOTE THAT PROGRAMS IN THIS AREA IN GENERAL WERE RANKED HIGHER IN PRIORITY THAN THE OTHER CATEGORIES AND THAT THIS AREA WAS ONE OF SIGNIFICANCE WITH REGARD TO A STRONG CONTINUED FEDERAL ROLE. SCIENCE AND TECHNOLOGY BASE PROGRAMS OF THE DOE COMPRISE OVER A BILLION DOLLARS* OR 28 PERCENT OF THE DOE'S FY 1982 PRESIDENT'S BUDGET. TWO KEY AREAS ARE OF PARTICULAR IMPORTANCE IN THE VIEW OF ERAB. THE FIRST IS RESEARCH ON CO_2 ACCUMULATION MECHANISMS AND CLIMATE EFFECTS. THE SECOND IS RESEARCH ON THE CAUSES, EFFECTS, AND CONTROL OF ACID RAIN. NUMEROUS OTHER AREAS OF SCIENCE AND TECHNOLOGY BASE ARE RATED AS HIGH PRIORITIES FOR FEDERAL RESEARCH AND ARE SHOWN IN TABLE 1.

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* ALL OF THE FIGURES QUOTED HERE ARE WITH REFERENCE TO THE FY 82 PRESIDENT'S BUDGET SUBMITTED IN MARCH OF 1981.

B. Electric-Related Supply Technology

Electric-related supply programs constitute over two billion, or 55 percent of the total DOE budget. The ERAB concluded that the highest priority should be given to the support of nuclear waste disposal programs, conventional reactor systems and safety, the Liquid Metal Fast Breeder Reactor base programs, and uranium enrichment R&D.

At the same time, ERAB recommended that some electric energy supply R&D programs could be reduced including small reductions for magnetic fusion, and significant reductions in the Clinch River Breeder, the Light Water Breeder, electricity transmission, and high temperature geothermal programs. I would add that the Committee was divided, with a strong dissenting opinion reported, regarding the recommendation to reduce the Clinch River Breeder project.

Other reductions in funding included the recommendation for the phase-out of hydropower and MHD programs. The Board also noted that the 55 percent fraction of the DOE's funding budget is substantially in excess of electric contributions to current and projected future energy supply.

C. Fuel Supply Technology

The fuel supply technologies of DOE report approximately 9 percent of the total FY 82 President's budget, or approximately $360M. This sector of energy supply is not as highly regulated as the electric energy industry and has historically developed these supplies with private resources. In general, ERAB concluded that

ENERGY TECHNOLOGIES SUCH AS ENHANCED GAS AND OIL RECOVERY CAN HAVE AN EARLY IMPACT IN THE MARKETPLACE BUT THAT THE FEDERAL ROLE IS SIGNIFICANTLY LESS SINCE PRIVATE INDUSTRY SHOULD DEVELOP THESE SOURCES. THE BOARD RECOMMENDED THAT THESE PROGRAMS COULD THUS BE REDUCED AND THAT THE MAJOR FEDERAL EFFORT IN SYNTHETIC FUEL RESEARCH AND DEVELOPMENT BE DIRECTED AT INNOVATIVE CONCEPTS AND SMALL, PILOT-PLANT SCALE. ERAB ALSO RECOMMENDED THAT FUEL SUPPLY R&D FUNDING BE DIRECTED AT PRODUCING LIQUIDS AND GASES FROM BIOMASS. THEY CONCLUDED THAT ALCOHOL PRODUCTION R&D IS AT AN APPROPRIATE LEVEL IN THE PRESIDENT'S BUDGET. IN RECOGNIZING ENVIRONMENTAL CONCERNS DUE TO FOSSIL FUELS DEVELOPMENT, ERAB SUGGESTED THAT PARTS OF THE ADVANCED RESEARCH AND ENVIRONMENTAL CONTROL TECHNOLOGY PROGRAMS CONCERNED WITH CONTROL OF SO_x AND NO_x AND PARTICLE EMISSIONS BE INCREASED AND STRENGTHENED.

D. UTILIZATION AND CONSERVATION TECHNOLOGY

THE ENERGY CONSERVATION AND END-USE TECHNOLOGY PROGRAMS COMPRISE 8 PERCENT OF THE DOE FY 82 BUDGET OR APPROXIMATELY $294M. ERAB CONCLUDED THAT THE R&D FUNDING WAS TOO LOW COMPARED TO THE SUPPLY TECHNOLOGIES AND RECOMMENDED THAT A BETTER BALANCE WITH OTHER PROGRAMS NEEDS BE ACHIEVED BY INCREASING FUNDS ALLOCATED TO BUILDINGS AND COMMUNITY SYSTEMS IN INDUSTRIAL CONSERVATION.

THE BOARD FELT THAT IMPLEMENTATION OF THESE RECOMMENDATIONS COULD LEAD TO A MORE JUDICIAL BALANCE OF THE DOE'S R&D BUDGET AND TO A REDUCTION IN THE TOTAL BUDGET COMPARED TO FY 81.

IV. Federal Role In Energy R&D

With regard to Federal role, ERAB agrees with the Administration's policy of greater reliance on the private sector whenever possible. We agree with the restoration of a free market in petroleum. ERAB believes that much, perhaps most, of new energy supplies and greater efficiency in energy use will in fact be achieved by higher energy prices. But ERAB is also concerned that some energy R&D of great potential significance for the achievement of the Nation's energy goals will fall between Federal and industry responsibilities. The new policy recognizes that private industry cannot be expected to do basic energy research or projects of a long-term, higher-risk character. But there are other circumstances in which it would be unrealistic to expect timely and effective assumption by industry of R&D responsibilities abdicated by the Government, however worthy the projects involved, and despite the provision of new generous tax incentives.

A little over half our primary energy finds its way to consumers through the electric and gas utilities, and the utilities are regulated, price-controlled industries, selling their products not at free market prices, but at controlled prices well below replacement cost. Both these regulated industries have relatively weak incentives to spend on R&D. In addition, some energy-related industries are too fragmented to organize and finance a strong R&D response to market signals.

The Administration has shifted toward research with longer range impacts. ERAB does not question this shift as a general proposition as long as it recognizes valid exceptions. Indeed, private industry

IS NOT LIKELY TO UNDERTAKE LONG-RANGE HIGH-RISK R&D. IT IS ALSO THE AREA IN WHICH ENERGY R&D CAN EXPECT THE HIGHEST PAYOFFS AND ADDRESSES THE GREAT NATIONAL ENERGY OBJECTIVES -- AFFORDABLE AND ENVIRONMENTALLY BENIGN SOURCES OF ELECTRICITY AND FLUID FUELS, USED EFFICIENTLY, FOR THE INDEFINITE FUTURE.

ERAB IN ITS EVALUATIONS OF PROGRAMS TOOK THE NEW POLICIES AND GUIDELINES RELATIVE TO THE FEDERAL ROLE VERY SERIOUSLY, BUT ERAB HAS MADE EXCEPTIONS WHERE THERE IS REASONABLE CERTAINTY THAT TIMELY AND ADEQUATE RESPONSE BY INDUSTRY AND COMMERCE IS AN UNREALISTIC ASSUMPTION, AND THAT CONTINUED FEDERAL RESEARCH SUPPORT IS THEREFORE STILL REQUIRED, AT LEAST FOR A TIME.

V. OBSERVATIONS

CHAIRMAN FUQUA ALSO ASKED ME TO COMMENT ON THE STRENGTHS AND LIMITATIONS OF THE REPORT. MOST OF THESE ARE IMBEDDED IN THE ADVISORY PROCESS ITSELF OR THE ADEQUACY OF THE KNOWLEDGE BASE FROM WHICH WE MUST ALL FORM OUR JUDGEMENTS ABOUT ENERGY TECHNOLOGY.

IN PARTICULAR, WE HAD SOME DIFFICULTY WITH THE RELIABILITY, OBJECTIVITY, AND COMPARABILITY OF TECHNICAL ASSESSMENT DATA ON ADVANCED ENERGY TECHNOLOGY. INDEPENDENT SYSTEMS ANALYSES AND TECHNICAL ASSESSMENT CAPABILITIES HAVE NOT BEEN ADEQUATELY DEVELOPED AND THE QUANTITY OF PAPER STUDIES TENDS TO OUTWEIGH THE QUALITY. THE BOARD'S EFFORTS WOULD HAVE BEEN AIDED BY SIMILAR INHOUSE WORK.

As you might expect, the Board members' expertise was stronger in some areas than others, although we were able to draw on DOE and other outside experts for inputs as needed. The lasting contribution of the report is not the individual rankings since these may change as new data becomes available and many people will take issue with our judgements, but rather in the overall perspectives and concepts advanced about R&D priorities and Federal role.

More importantly, there are a number of strengths and limitations in the advisory process itself. As you know, Federal advisory committee regulations require that the membership represent the balance of viewpoints and that meetings are open to the public. The Board's membership (listed in the report) does include a wide spectrum of views which not only insures many spirited debates but also independent advice that is not always in concert with the Administration. In accordance with the Federal Advisory Committee Act (FACA) rules a very real effort has been made to include the required variety of viewpoints in ERAB.

The strength of this process is in providing the independent judgement of a diverse group of outside experts. On the other hand, the Board does not have the benefit of timely access to all budgetary and technical information nor internal deliberations of the Department on R&D policy before the fact. Thus, the limitation of the advisory process is in keeping pace with policy developments in order to provide timely and relevant advice.

As I mentioned before, the DOE Act only allows our meetings to be closed for two of the Federal Advisory Committee Act/Freedom of Information Act provisions, so we cannot receive internal information. Of course, the Board's role is advisory only and has no direct voice in policymaking.

In this regard, I draw your attention to a recent report of the Charles F. Kettering Foundation titled Federal Advisory Committees: An Important Frustration which raises important issues regarding the integrity and utility of the Advisory Committee process. This may be of some concern to this Committee because of the special role of science and technology advice in providing technical information and judgement to Government.

I would also call your notice to a 1978 report of the National Research Council of the National Academy of Sciences: Private Sector Participation in Federal Energy RD&D Planning. That report explored in some detail the complexities and constraints that inhibit the Federal advisory committee process and recommended the establishment of a formal Advisory Board reporting to the Secretary of Energy. Three members of the present ERAB, including myself, served on the NAS/NRC Committee.

Copies of these two reports and the ERAB R&D Priorities Report are hereby submitted to the record.

This concludes my summary of our conclusions; I would be happy to answer any questions you may have regarding our report.

Mr. FUQUA. Thank you, gentlemen, for your testimony today.

Mr. Davis, in looking at the testimony of Mr. Roddis and the attached chart indicating the relative ranking for DOE programs by ERAB that you referred to, I noticed that University Research received a high priority. It is funded at $10.6 million in fiscal year 1982, and in the funding category the report is quoted as saying "more".

Then I notice that in the budget request for fiscal year 1983 University Research, it has been cut from the $10.6 million down to approximately $5 million for fiscal year 1983.

Also, there was a modest $1 million in that program for the energy traineeship program for graduate students, and that was eliminated from the budget request.

What was the rationale used by DOE in making these decisions?

Mr. DAVIS. Well, I think our basic problem has been to try to allocate the resources that are available, and I am not sure I can tell you the specific reasons, but we had to look very hard at all parts of the budget to try to make the reductions that were necessary.

The university research as such is certainly one item; of course, much of the other work that is done by the Department does go to the universities as well, so this is not the total amount that does go to the universities.

Mr. FUQUA. But you have, I think, testified, and Secretary Edwards testified yesterday, we were supporting long-range, high-risk basic research.

That was the basis that we were using to determine budget priorities, but, I am not trying to put words in your mouth. However, I think you said something along those lines.

Mr. DAVIS. That clearly is one of our objectives but that does not mean that we can continue to support at the same level all of the activities related to that and it is clear from looking at the fiscal year 1983 budget that we will not be able to do that, so it has been a question of trying to make judgments as best we could as to where we ought to apply those funds that are available to us.

The funding directory, and in terms of some contract work, so we have reduced the direct funding, it is true. I can't give you the totals. We could try to supply that for the record, if it would be useful.

Mr. FUQUA. Mr. Roddis, in your report, you point out that there are increased operating costs associated with the major research facilities, particularly those such as the neutron sources, and that they have squeezed many of the basic energy science subprograms because of these higher operating costs.

Is improved long-range facility planning required in the basic energy sciences similar to what we already have adopted for the high energy and nuclear physics program, and did you look into that very thoroughly?

Mr. RODDIS. This report did not specifically include that point.

We make the recommendation in each of these areas for greater funding, first to handle the obvious problems of inflation, because identical money does not mean identical people in subsequent years.

We have also now operating in ERAB a panel aimed at better understanding and making some recommendations in the area of

the role of the large multipurpose national laboratories which include most of the facilities you are speaking about and the people.

That panel is in the midst of its deliberations right now, and we hope to come up with a preliminary report in the near future and a final report in September.

Mr. FUQUA. Mr. Roddis, one of the questions that we have debated in this committee, and I guess it is a continuing debate, is support for development work. Where does research begin and where does it end? Does it end with a small-scale laboratory experiment or do you go ahead and build a large-scale prototype so that you can prove the practicality of what has been developed in a laboratory?

Can you help us on that? What is the proper Federal role?

Mr. RODDIS. I believe the proper role varies with industry and technology. We are in two areas in ERAB at the moment trying to deal with this problem.

Of course, in making our R. & D. priorities report, one of the seven criteria was Federal role and we did recognize a different Federal role in different energy technologies. I touched a little bit in my testimony on this, that the regulated industries in the electric and gas supply area are in a very different situation than in the nonregulated areas in solid fuel supply business.

We have two panels that are specifically looking at this and the related problems, in the solar and conservation area.

The panel in conservation has had two, I believe it is, perhaps three meetings. The solar panel is still in the process of being chartered and put together, but it is clearly our intention to look at the Federal role.

We also have talked about and at the next meeting I hope we will reach some agreement on the third phase of our overall priorities report.

You may remember that I said in 1980 we addressed the issue of science and technology base. This past year, the major effort was directed at the issue of R. & D. priorities in the different categories.

It is my intention, as Chairman, to try to get ERAB to look at whether we can address the Federal role in other specific areas in a more helpful fashion.

There is certainly no argument on my part, nor do I think on the part of any significant number of members, that the general challenge of longer range and higher technological or economic risks is a perfectly good generic statement, but when you start to particularize this, you can do a lot of different side scale things when you are dealing with a generator whose maximum size is 4 or 5 megawatts, like a wind machine, where the expected full-scale size is a million kilowatts, like the breeder.

These are different problems and we are trying to examine them on that basis.

Mr. FUQUA. Mr. Roddis, in your testimony, you note that ERAB does not question, or did not question, the administration's shift toward research with longer range impacts as a general proposition as long as it recognizes valid exceptions. What are your exceptions?

Mr. RODDIS. ERAB has not yet examined the issue of what the specific exceptions are, except that by agreeing to set up a panel in the conservation and in the solar areas, we clearly recognize those

are two areas where we want to take a harder look and, as I say, across the spectrum, we are still discussing whether it would be constructive for us to try to take all of the industries involved. That is quite probably to take all of them.

Mr. FUQUA. I noticed in industrial conservation and building community systems, you recommended more funding, and I think that has been almost eliminated in this budget.

Do you have different priorities than DOE?

Mr. RODDIS. I can only stand on the record of what our recommendations were.

Mr. FUQUA. Mr. Davis, you mentioned in your testimony, and I quote:

> Where programs are terminated, we have determined that these efforts are not appropriate for Federal support. And, if there is an economic potential, private industry will support.

What methodology did you use in making that determination on which programs should be terminated?

Mr. DAVIS. Well, the whole budget preparation process, of course, is basically one where we in effect try to express our philosophy to our various program assistant secretaries.

They then review the programs with their people and make recommendations to the budget people, and it works its way up through the Office of the Secretary and it is reviewed by OMB.

I think it is not a particular process for a particular subject. It is a general process of assembling budgets, reviewing them, having to make some pretty hard decisions at various levels, and then coming forth with what we think is a reasonable budget and we then have to review it with the OMB and generally make some further changes, but that is the way it evolves.

Mr. FUQUA. Really, OMB made the decision.

Mr. DAVIS. OMB reacts to what we propose and we sometimes have some considerable discussion before a final decision is arrived at.

Mr. FUQUA. In those programs where decisions were made to terminate, are you trying to insure that we can couple that technology and transfer it to private firms and encourage them to pick it up?

Mr. DAVIS. In some cases, the technologies that we may have dropped do not seem to be of particular interest to industry. In other cases, where our feeling is that industry would be interested and pick it up, we have tried to make sure that they had the information and that they had every opportunity to do so, and I might comment that I think that in many cases where we have dropped various technologies, there is a pretty good indication that the industry will pick them up in whole or in part.

They will pick up those that they think really have some economic promise.

Mr. FUQUA. Why is industry not picking it up more? Is it that the risk is too high or the technology is faulty?

Mr. DAVIS. In some cases I think the technology just isn't that attractive.

Mr. FUQUA. But you think that most of those technologies that have a promise for commercialization, that industry is picking

them up, even though they may have a high risk in the development stage?

Mr. DAVIS. I have been encouraged by some of the things I have heard that the industry is taking a pretty close look at many of the things that we are backing off from, and where they do think it has some economic attractiveness, that they are preparing to pick them up.

Mr. FUQUA. Mr. Davis, I am sure we talked to a lot of the same people from industry that have various proposals. I find many of them are coming in with technologies that they believe, with a small amount of continued funding, would be able to be successful in a commercial operation. But they do not feel under the conditions that exist with their companies, that they can provide the high-risk capital to continue them further.

Mr. DAVIS. I have a number of such conversations quite too frequently. I certainly have an industry background. Some of them we don't feel are simply worth supporting. In some cases the proposers think they are, and it is simply a difference of opinion.

Mr. FUQUA. Mrs. Bouquard?

Mrs. BOUQUARD. I ask that my opening statement be made a part of the record.

Mr. FUQUA. It has already been made a part of the record.

Mrs. BOUQUARD. I asked the Scientists and Engineers for Secure Energy [SE_2] to submit its comments on the ERAB report on Federal energy R. & D. priorities and I would like to ask permission that the SE_2 response be made a part of the record.

Mr. FUQUA. Without objection, so ordered.

[The information follows:]

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March 3, 1982

The Honorable Marilyn L. Bouquard
Chairman
Subcommittee on Energy Research and Production
U.S. House of Representatives
Rayburn House Office Building; Room B-374
Washington, DC 20515

Dear Chairman Bouquard,

Scientists and Engineers for Secure Energy (SE_2) appreciates very much your invitation to submit its comments concerning the recent "Report of the Energy Research Advisory Board on Federal Energy R&D Priorities" to your Subcommittee.

In reviewing the nation's current energy needs, the Board correctly singles out conservation as a major factor. Coupled with current economic stagnation, conservation may, indeed, significantly affect the growth projection for the near term.

However, while conservation is a helpful tool for the rational management of the available inventory of energy, it is not by itself a source of energy. Also, one can manage only what one has, and the hoped-for revitalization of our economy, continued growth of the U.S. population, and the promises which offer a better life to the more unfortunate of our citizens require continuous further availability of secure and expandable sources of power. A meaningful R&D program must, therefore, effectively address all of these concerns: (a) the security of resources, (b) expansion of our energy production, and (c) the modification of our energy mix as we progress into the future. In this context, the Report seems to have missed or avoided several significant issues which can be summarized as follows:

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1. The ERAB Report accepts oil as a facile balancing factor for its predictions and, thus, implicitly acquiesces to our still-unacceptable dependence on oil imports. Indeed, the authors of the Report acknowledge this problem by pointing out that "a major perturbation in the oil import segment would play havoc with all projections." Also, a recent General Accounting Office Report (EMD-81-117) reminds us that the United States is still unprepared for, and susceptible to, serious economic problems from oil import disruptions. Thus, the continued instabilities in, and the unpredictability of, the international oil market should alone provide this nation with justification for aggressively pursuing alternate energy paths that offer the maximum potential for continued oil substitution and import reductions.

2. The Report fails to make a clear distinction between the role played by energy growth, in general, that played specifically, by electricity. Recent studies conducted at the Electric Power Research Institute (EPRI) and the Oak Ridge National Laboratory (ORNL), among others, reveal the existence of a strong corelation between GNP and electricity growth. In fact, recent analysis at Harvard University calls into question the ability of the United States economy to recover if electrical supply capabilities remain insufficient.

In the economic life of the U.S. (and throughout the Western World), electricity has taken on an ever-expanding role. The share of primary energy devoted to electricity production continues to increase at a remarkable rate -- from 9% in 1925 to 33% today, and it is expected to be 46% by the year 2000. This trend points to the critical "lifeblood" role of electricity for the economy of any country. It is of no surprise that analyses performed at EPRI show a strong and consistent relationship between electric growth and GNP, from 1947 to 1979.

An improvement in the economy at any time in the coming years is likely to be accompanied by dramatic surges in the demand for electricity. Some evidence for this can be found even now in the electric growth rate in the U.S. from 1980 to 1981. According to the National Electric Reliability Council (NERC), increases in electrical demand of 6.4%, 8.7%, 8.9%, 9%, and 16.3% experienced in five regions of the country were due primarily to normal or healthy economic growth. Thus, electricity generation deserves a more specialized treatment than was accorded it by the Report Board.

3. The Report makes no reference to the role of electricity in the marketplace as a mechanism for improving overall energy effi-

ciency and for oil substitution. Recent work at the Argonne National Laboratory, ORNL, and Harvard University, among others, points to the fact that electric heating can be economically as good or better (and energy efficient) as conventional oil heat. An ORNL analysis points to a total technical potential for electric substitution for oil in the marketplace of more than 5 million barrels of oil per day by the year 2000. For example, the technologies for using electricity in steel- and glass-making and for residential and commercial electric heat-pumps are well established and documented as both energy efficient and economical. The potential magnitude of the contribution from electric generation, and the inherent advantages of indigenously abundant supplies of coal and uranium, argue for a more comprehensive analysis of these factors, and indeed, point to the potent role breeder reactor technology may play in the foreseeable future. Like in France, electricity may become the key factor for making the United States secure from the vagueries of oil.

4. A large number of recent and comprehensive analyses (including the National Academy of Sciences CONAES study) point to the fact that coal and uranium are the principal, significant sources of readily-available and expandable energy. Currently, the country is committed to aggressive expansion of its dependence on coal, despite the fact that the difficulties associated with an overdependence on any single fuel source should have been amply demonstrated by our current and past problems with oil. For example, according to the Report, an accumulation of CO_2 in the atmosphere could become a "show stopper" not only for coal but for all fossil fuels, and wood as well. In such a case, nuclear would become the principal "swing" fuel, and dramatic increases in the supply (and therefore consumption) of uranium would be necessary. Likewise, greater nuclear generating capacity would be needed than is presently considered in the Report. In this context, EPRI estimates that more than 300 GWe of nuclear capacity will be needed by the year 2000. Consequently, problems in the expansion of coal, even within a modestly growing economy, could create a demand for uranium sufficient enough that breeder reactor technology could be needed much sooner than currently envisioned.

5. Against this background, relegating the Clinch River Breeder Reactor (CRBR) project to the "low priority" category -- as was done in the Report -- misrepresents the role of LMFBR's, and in particular, the CRBR demonstration. The Clinch River project is a necessary step in bringing the LMFBR program out of the paper-study and experimental phase and into the realm of practical use. The project will serve to verify and investigate design decisions

and provide the United States with an option for an orderly transition, if such a transition is needed, to a virtually unlimited fuel supply for electric energy production. (It is worth noting that the waste at U.S. enrichment facilities -- the tailings -- alone has an energy value, if used in a breeder program, of some two times this county's coal reserves. Therefore, following its review of the Report, SE_2 reaffirms the need for proceeding with the Clinch River project, now. This reaffirmation comes in line with the previous recommendations made by SE_2 in its June 2, 1981 letter to you and your Subcommittee. (copy attached)

Because of the importance of these considerations, SE_2 urges that the significance of electricity growth, the relation of electricity growth to the GNP and productivity, the proper role of the energy mix (including emphasis on coal and nuclear), and the need for, and timing of, breeder reactor development (including proceeding with the Clinch River project) be accorded major attention in considering the implications of the ERAB Report.

* * * * * *

In closing, SE_2 is grateful for the opportunity to present its views on this matter of great importance to the future well being of this country.

Sincerely,

Frederick Seitz

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SE2

June 2, 1981

The Honorable Marilyn L. Bouguard, Chairwoman
House Subcommittee on Energy Research and
Production
Rayburn House Office Building, Room B-374
Washington, DC 20515

Dear Congresswoman Bouquard,

Scientists and Engineers for Secure Energy (SE2) feel greatly honored by your request to acquaint the Subcommittee which you chair and other members of Congress with SE2's views concerning the future of the Breeder Reactor Plant at Clinch River.

Today, a substantial majority of SE2's membership is strongly in favor of continuous funding for this most important project. Rather than to repeat the detailed analysis which led us to support the ongoing development of the Liquid Metal Fast Breeder Reactor (LMFBR) technology in the United States -- an analysis which by now must be quite well known to all interested parties -- let us here summarize the main reasons which compel most members of the SE2 Steering Committee, and many other experts within our organization, to come out on the side of the Clinch River Breeder Reactor Project (CRBRP).

(1) LMFBR is the only, already proven technology which can serve as quaranteed insurance against possible, future energy crises.

(2) At the time of possible, future deployment, LMFBR's will be a secure, and most probably economical way by which to convert nuclear power technology into a truly renewable energy resource of unlimited potential.

(3) In many respects, the CRBRP is the most advanced development project of its kind. If promptly pursued and properly followed up, it may

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may open the way for the United States and the world to acquire, by the turn of the century, a fully commercially applicable, advanced breeder technology at precisely the time when a massive introduction of such a resource may become necessary.

(4) In view of recent political developments in certain Western countries, particularly France, the Clinch River Breeder Project may become the only reliable technological undertaking of its kind in the Free World.

Together, the four above points constitute a powerful case for the continuation of CRBRP. Incidentally, our support for the steady development of the LMFBR technology in this country does not in any way reduce our enthusiasm for the search for, and development of, alternative avenues for the secure generation of nuclear power. In particular, we fully endorse the call by Edward Teller for an ongoing assessment by a national body of technological experts of various known and promising technical options. Such work should yield practical proposals which could serve as useful guides for future Congressional and Administrative action. Nevertheless, we strongly believe that such an assessment of additional alternatives should proceed concurrently with the vigorous, and rapid, development of the Clinch River Plant.

The United States urgently needs the working experience and trained personnel which only an ongoing CRBRP can provide. We trust that the Congress will, in the best national interest, provide the required funds.

For the Scientists and Engineers for Secure Energy:

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New York Polytechnic Institute

Robert Hexter
University of Minnesota

Erich Isaac
City University of N.Y.

Robert S. Mulliken
University of Chicago

Thomas Pigford
U. of California, Berkeley

James Rainwater
Columbia University

Norman C. Rasmussen
MIT

Dixy Lee Ray
Dixy Lee Ray

Frederick Seitz
Rockefeller University

Miro H. Todorovich
City Univeristy of N.Y.

Alexander von Graevenitz
University of Zurich

Alvin Weinberg
Oak Ridge Associated Universitie

Eugene Wigner
Princeton University

*Attached are personal letters from Drs. Benedict and Wigner

Mrs. BOUQUARD. This response states that "A meaningful R. & D. program must * * * effectively address all of these concerns: (*a*) The security of the resources, (*b*) expansion of our energy production, and (*c*) the modification of our energy mix as we move into the future." In this context, the report seems to have missed or avoided several significant issues.

Now, I would like to summarize a couple of SE_2's comments and ask for your response.

The ERAB report accepts oil as a facile balancing factor for its predictions and, thus, implicitly acquiesces our still unacceptable dependence on oil imports. Indeed, the authors acknowledge this problem by pointing out that a major perturbation in the oil import segment would play havoc with all projections.

In other words, the imported oil problem was not a major consideration in reaching the conclusions that were made. The unpredictable nature of our international oil market was not really placed in proper focus in looking to our energy future.

Would you care to comment on that, Mr. Roddis?

Mr. RODDIS. The issue clearly was recognized by the members. One of the priority categories on the three energy supply technology areas involved the issue of supply security.

Exactly how one evaluates what you ought to do in the way of research and development against such things is what we presented in the report. Most of those problems of security are related to matters other than research and development, and I have not had a chance to read the document and, obviously, I can't speak for the Board on a response until I meet with the Board.

Mrs. BOUQUARD. Conservation in itself is not a source of energy. It is well and good, but it is not a source of energy.

Mr. RODDIS. That is, of course, true, but the balance ultimately is what you require to do the job on an economic basis. There is a whole series of scenarios here and we elected to present for the sake of uniformity, we adopted the scenario that the Department presented in the 1981 third energy policy plan.

It happens to be a number, 100Q in the year 2000, which sort of is in the middle of a number of scenarios. We did not in this report do any further research on it. During the previous study in 1981, we did do quite a lot trying to arrive at a mutual agreement about what one of the many scenarios we would stick with, and we agreed on adopting the one that ultimately became the plan.

Mrs. BOUQUARD. In a different scenario, different priorities would have been established.

SE_2 also notes:

> A large number of recent and comprehensive analyses, including the National Academy of CONAES Study, point to the fact that coal and uranium are the principal, significant sources of readily available and expandable energy. Currently, the country is committed to an aggressive expansion of its dependence on coal, despite the fact that the difficulties associated with an overdependence on any single fuel source should have been amply demonstrated by current and past problems with oil.For example, accumulation of CO_2 in the atmosphere could become a show-stopper not only in coal but for all our fossile fuels, and wood as well. In such a case, nuclear would become the principal swing fuel, and dramatic increases in the supply (and therefore consumption) of uranium would be necessary. Likewise, we are going to have to have greater nuclear generating capacity, would be needed, than is presently considered in the report * * *. Consequently, problems in the ex-

Taken from INSIDE ENERGY - December 11 1981 compilation of data [illegible] R&D Priorities Rpt

RELATIVE RANKING OF DOE PROGRAMS BY ERAB

(Dollars in millions)

Electric Supply		Fuel Supply		Conservation & Utilization		Science and Technology Base[1]	
Programs/FY-82 Request	Pending	Programs/FY-82 Request	Pending[3]	Programs/FY-82 Request	Pending	Programs/FY-82 Request	Pending
PRIORITY – HIGHER						Materials Science $112.1	More
						Climate & CO_2 Research $16.7	More
						Chemical Sciences $73.9	More
Commercial-Nuclear Waste (NE) $227.6	Same						
						Health/Environmental Research $170.5	More
						Biological-Energy Sciences $9.4	More
				Coal Combustion (FE) $38.8	Same	Nuclear Medicine $50.5	Same
Defense-Nuclear Waste (DP) $390.0	Same			Buildings/Community Systems (CE) $28.0	More	High-Energy Physics $392.7	Same
				Industrial Conservation (CE) $0.0	More	University Research $18.6	More
		Enhanced Oil Recovery (FE) $20.1	Less			Environment & Safety $49.6	Same
						Engineering/Math/Geoscience $32.3	Same
						Nuclear Physics $122.9	Same
PRIORITY – MEDIUM							
Conventional Reactors (NE) $68.0	More	Advanced Research and Environmental Control Technology (FE) $94.5	Same	Transportation Conservation (CE) $37.0	Same		
		Enhanced Gas Recovery (FE) $10.2	Less	Solar Applications for Buildings (CE) $84.7	Same		
Breeder-Fuel Cycle r&d (NE) $26.1	Little Less					Nuclear Sciences $37.7	Same
Centrifuge (NE) $64.5[2]	Same						
LMFBR (base program-NE) $387.8	Same			Heat-Engines and Heat Recovery (FE) $15.6	Same		
		Coal Liquefaction (FE) $105.2	Less			Advanced-Energy Projects $8.2	Same
Solar-Power Technology (CE) $19.4	Less			Multi-Sectors Conservation (CE) $17.5	Same		
Advanced-Isotope Separation (NE) $94.2	Same			Fuel Cells (FE) $28.6	Same		
		Biomass Energy (CE) $20.5	Same				
		Surface-Coal Gasification (FE) $53.4	Less				
PRIORITY – LOWER							
		Mining r&d (FE) $21.9	Less	Solar Applications for Industry (CE) $44.0	Less		
Magnetic Fusion (ER) $456.1	Little Less	In-Situ Oil Shale (FE) $16.3	Less			Technology Assessments $3.0	Same
Light-Water Breeder Reactor (NE) $58.0	Less						
Uranium Resources Assessment (NE) $5.8	Same						
Electric Energy/Storage Systems (CE) $47.5	Less						
Hydropower (CE) $0	Zero						
Clinch River Breeder Reactor (NE) $254.0	Less						
Geothermal (CE) $46.8	Less						
		Alcohol Fuels (CE) $10.0	Same				
		In-Situ Coal Gasification (FE) $8.3	Less				
Magnetohydrodynamics (FE) $0.0	Zero						

[1] Science and technology base programs were evaluated by a different set of criteria than the r&d programs and are not directly comparable to them.

[2] Excludes $695.8 million for centrifuge-plant construction.

[3] Budget numbers refer to President's FY82 request of March 1981 (excluding program direction).

pansion of coal, even within a modestly growing economy, could create a demand for uranium sufficient enough that breeder reactor technology could be needed much sooner than currently envisioned.

I would like for both of you to comment on that, please.

Mr. RODDIS. First, the Board clearly recognized the significance of coal and the need for the understanding of the acid rain phenomena in technical detail. I am not sure whether it is a problem or not, but it is certainly not understood.

Likewise, the CO_2 and its long-term impact are clearly show stopper kinds of events. We clearly recognize that, and we recommended increased spending specifically in all of the areas, and they are not all in that one line item. There are some other items. We recommended more funding in that area.

On the matter of nuclear power, we also recommended more funding on so-called conventional light water systems.

Mrs. BOUQUARD. That is the point I was trying to make. I am talking about uranium supply. You have not addressed that problem properly in this report.

Mr. RODDIS. We certainly addressed the uranium enrichment issue and the conventional reactor system issue.

The question of uranium supply is really an assessment activity, and the question is to find out with some degree of definitiveness how much uranium you have.

We recommended that that process be continued at a somewhat reduced level from what it has been in the past; a level which was consistent with the exploitation of the information that could be obtained with some additional drilling.

In other words, there is a lot of that assessment that comes from existing drilling just making the records. If you will look at our recommendations, they were to maintain the same level as the President's March request, which was roughly $6 million. Congressional appropriations was 10, and in the previous year it was 30.

The difference between the 6 and 30 is primarily additional drilling, and that is really a matter of how fast you find things.

Mrs. BOUQUARD. Mr. Davis, would you care to comment on that?

Mr. DAVIS. Well, I think that, first of all, to deal with the coal and the CO_2 problem, I think that our feeling is that that is being adequately addressed, and we have had conversations with the ERAB as to whether or not anything more really needs to be done at the present time.

The feeling is that is being looked at by a great number of different people, including the academies, quite extensively. As far as the uranium issue is concerned, we are very much interested in that in terms of satisfying the requirements for the future nuclear power program.

However, in terms of the assessment that has been mentioned, our feeling is that, or not the feeling but the situation is that most of the assessment work has actually been completed, and this is the work that this is being phased out. Not much more would be learned in terms of accuracy by continuing to pursue that on a continuing basis.

It is sort of a one-time look at the possible reserves, and so on. That assessment has not changed the picture that we have had previously in any substantial way.

Mrs. BOUQUARD. There was a dissenting report filed with respect to the relegation of the Clinch River Breeder project to the low priority category.

Would you give us a little bit more information with regard to CRBR?

Mr. RODDIS. The Board adopted as its position the following words:

"The ERAB believes that the construction of a breeder reactor demonstration at this time is not an urgent priority, and thus under current budget constraints, recommends that such a demonstration be delayed until a future time."

This is immediately following a paragraph fully supporting the twice larger effort on base program and fuel cycle research and development with the words:

"Breeders with intended reprocessing should have a high ultimate impact on energy supply security. The Board recommends this base technology be maintained."

Mrs. BOUQUARD. You addressed the supporting positions; you didn't address the dissenting position.

Mr. RODDIS. I am trying to say what ERAB adopted as a position. That is the statement.

The dissenting position which I am a signator of is presented in four pages, and there is also a concurring opinion from one of the other ERAB members, Tom Cochran, who is in the room.

The dissenting opinion is essentially in consonance with the comments of Scientists and Engineers for Secure Energy recommending the need for a long-term base program.

You cannot turn major programs off and on all the time, and make any progress on them. You have to maintain your staff and your continuity, and that is basically the position of the four of us that signed the dissenting opinion.

As I say, Tom Cochran also submitted an additional extension of his views on why he supported the majority opinion.

Mrs. BOUQUARD. Thank you very much.

Thank you, Mr. Chairman.

Mr. FUQUA. Mr. Wolpe.

Mr. WOLPE. Thank you, Mr. Chairman.

I have three particular questions that I would like to put to panelists this morning.

I do want to begin with a few observations.

I guess I am struck, Mr. Davis, by the extent to which the energy budget makes the work of ERAB essentially irrelevant.

I suspect Mr. Roddis feels a bit ignored on occasion. The more ERAB's views are voiced in public or other forums, the more fragile will become the tenure of ERAB and its membership, if this administration runs true to form.

Mr. Davis, on page 17 of the ERAB report, there are some tables that provide breakdowns of the fiscal year 1981 and fiscal year 1982 budgets as a function of energy form and timing of impact. Does the Department have any disagreement with that particular breakdown and, if not, can you accept that as a valid summary of the allocation of funding, both for fiscal years 1981 and 1982?

Mr. DAVIS. Mr. Wolpe, I think we have explained, and I can't generalize on the whole table, we have taken the ERAB input into account.

Mr. WOLPE. I am not asking at this point for your judgment or reaction to their recommendations. Do you have any particular quarrel with simply the summary of where dollars have in fact been flowing in the 1981–82 budget?

Mr. DAVIS. If you look at our fiscal 1983 budget you will see some substantial differences.

Mr. WOLPE. I am asking, is this accurate, is this an accurate summary of where dollars were flowing in 1981 and 1982?

Mr. DAVIS. I have not checked that table against the actual budgetary numbers, so I cannot answer that question. I will have it looked at and give you a reply.

[The information follows:]

The tables on pages 15 and 17 of the R. & D. Priorities Report were accurate at the time they were prepared last summer. They were based on statistical tables prepared by our Controller's Office, and accurately reflected the allocation of R. & D. funds. Both the fiscal year 1981 and the fiscal year 1982 numbers have changed somewhat since that time, as we now have an appropriation for fiscal year 1982 and actual obligations for fiscal year 1981.

Mr. WOLPE. Thank you.

Would you also do the committee a favor of having a similar breakdown prepared? I wonder if ERAB might do the same, if there is any dispute in terms of the numbers. It would be very useful to have a similar breakdown for the fiscal year 1983 budget request.

Can we get a commitment from you, Mr. Davis?

Mr. RODDIS. There is no difference between our numbers and the departmental numbers on the established budgets. There may be some difference between recommendations.

Mr. WOLPE. I want to get a data base so we know what we are talking about.

Mr. RODDIS. The data base on the tables on page 17 was in fact obtained from the Department and added together by our staff.

I should point out, it is 1981 estimated. It is the 1982 President's recommended budget, and not representative of what the final 1982 budget is.

Mr. WOLPE. I would also like to have a readout of the proposed 1983 fiscal year budget that would allow us to make comparisons with the tables, not only on page 17 but also the tables present on page 15 of the ERAB report.

Mr. DAVIS. It would be quite easy for us to give you that comparison, sir.

[The information follows:]

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TABLE III-C

FY 81 ACTUAL OBLIGATIONS AS A FUNCTION OF TECHNOLOGY AREA AND ENERGY FORM, MILLIONS OF $

OUTPUT ENERGY FORM / Resource Base	Electricity	Fuels	Utilization and Conservation	Science and Technology Base	TOTALS
Conservation	-	-	353.6	-	353.6 (8%) [10%]
Nuclear & Fusion	1,799.3*	-	-	-	1,799.3 (38%) [49%]
Coal	67.0	533.0	37.7	-	657.7 (14%) [18%]
Solar	227.0	49.7	366.3	-	643.0 (14%) [17%]
Geothermal	156.0	-	-	-	156.0 (3%) [4%]
Oil/Gas/Shale	-	78.4	-	-	78.4 (2%) [2%]
Science and Technology Base	-	-	-	981.3	981.3 (21%)
TOTALS	2,249.3	681.1	757.6	981.3	4,669.3 [3,688.0]
(% of Total)	(48%)	(15%)	(16%)	(21%)	
[less science and tech base]	[61%]	[18%]	[21%]		

* Centrifuge R&D Costs included, construction costs excluded.

[]signify Science & Technology Base funding excluded.

March 1982

TABLE III- D

FY 82 APPROPRIATION AS A FUNCTION OF TECHNOLOGY AREA AND ENERGY FORM, MILLIONS OF $

OUTPUT ENERGY FORM / Resource Base	Electricity	Fuels	Utilization and Conservation	Science and Technology Base	TOTALS
Conservation	-	-	201.8	-	201.8 (5%) [7%]
Nuclear & Fusion	1,982.4 [a]	-	-	-	1,982.4 (49%) [65%]
Coal	27.8	382.2	41.1	-	451.1 (11%) [15%]
Solar	114.7	30.5	149.1	-	294.3 (7%) [10%]
Geothermal	53.5	-	-	-	53.5 (1%) [2%]
Oil/Gas/Shale	-	45.2	-	-	45.2 (1%) [1%]
Science and Technology Base	-	-	-	1,009.0	1,009.0 (25%)
TOTALS	2,178.4	457.9	392.0	1,009.0	4,037.7 [3,028.3]
(% of Total)	(54%)	(11%)	(10%)	(25%)	
[Less science and tech base]	[72%]	[15%]	[13%]		

[a] Centrifuge R&D Costs included, construction costs excluded.

[] signify Science & Technology Base funding excluded.

March 1982

TABLE III- Y

PRESIDENT'S FY 83 BUDGET AS A FUNCTION OF TECHNOLOGY AREA AND ENERGY FORM, MILLIONS OF $

OUTPUT ENERGY FORM / Resource Base	Electricity	Fuels	Utilization and Conservation	Science and Technology Base	TOTALS
Conservation	-	-	27.0	-	27.0 (1%) [1%]
Nuclear & Fusion	1,993.2*	-	-	-	1,993.2 (62%) [92%]
Coal	-	66.8	6.5	-	73.3 (2%) [3%]
Solar	5.5	9.5	45.0	-	60.0 (2%) [3%]
Geothermal	9.8	-	-	-	9.8 <(1%) <[1%]
Oil/Gas/Shale	-	11.6	-	-	11.6 <(1%) <[1%]
Science and Technology Base	-	-	-	1,050.6	1,050.6 (33%)
TOTALS	2,009.5	87.9	78.5	1,050.6	3,225.5 [2,174.9]
(% of Total)	(62%)	(3%)	(2%)	(33%)	
Minus science and tech base	[92%]	[4%]	[4%]		

* Centrifuge R&D Costs included, construction costs excluded.

[]signify Science & Technology Base funding excluded.

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TABLE III-E*

FY81 ACTUAL OBLIGATIONS AS A FUNCTION OF ENERGY FORM AND TIMING OF IMPACT, MILLIONS OF $

	NEAR	MID	LONG	TOTALS
Electricity	837.3 **	542.5	869.5	2,249.3 (48%) [61%]
Fuels	96.0	542.9	42.2	681.1 (15%) [18%]
Utilization and Conservation	553.7	203.9	-	757.6 (16%) [21%]
Science and Technology Base	-	-	981.3	981.3 (21%)
TOTALS (% of Total)	1,487.0 (32%)	1,289.3 (28%)	[911.7] [25%] 1,893.0	4,669.3 [3,688.0]
[% less science & tech base]	[40%]	[35%]	(40%)	

*The timeframe for impact of the various technologies used in making the above table is given in Appendix B.

**Centrifuge R&D costs included, construction costs excluded.

[ ]signify Science & Technology Base funding excluded.

TABLE III-F*

FY82 APPROPRIATION AS A FUNCTION OF ENERGY FORM AND TIMING OF IMPACT, MILLIONS OF $

	NEAR	MID	LONG	TOTALS
Electricity	824.9**	419.1	934.4	2,178.4 (54%) [72%]
Fuels	57.5	373.9	26.5	457.9 (11%) [15%]
Utilization and Conservation	242.1	149.8	-	391.9 (10) [13%]
Science and Technology Base	-	-	1,009.0	1,009.0 (25%)
TOTALS (% of Total)	1,124.5 (28%)	942.8 (23%)	[960.9] [32%] 1,969.9	4,037.2 [3,028.2]
[% less science & tech base]	[37%]	[31%]	(49%)	

*The timeframe for impact of the various technologies used in making the above table is given in Appendix B.

**Centrifuge R&D costs included, construction costs excluded.

[] signify Science & Technology Base funding excluded.

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TABLE III-7*

PRESIDENT'S FY83 BUDGET AS A FUNCTION OF ENERGY FORM AND TIMING OF IMPACT, MILLIONS OF $

	NEAR	MID	LONG	TOTALS
Electricity	922.6**	292.2	793.7	2,008.5 (62%) [92%]
Fuels	14.8	66.1	7.0	87.9 (3%) [4%]
Utilization and Conservation	62.5	16.0	-	78.5 (2%) [4%]
Science and Technology Base	-	-	1,050.6	1,050.6 (33%)
TOTALS	999.9	374.3	[800.7] [37%]	
(% of Total)	(31%)	(12%)	1,851.3	3,225.5 [2,174.9]
[% less science & tech base]	[46%]	[17%]	(57%)	

*The timeframe for impact of the various technologies used in making the above table is given in Appendix B.

**Centrifuge R&D costs included, construction costs excluded.

[ ]signify Science & Technology Base funding excluded.

Mr. WOLPE. Mr. Davis, I think there is a general consensus in this Nation that the primary goal of our energy policy should be to reduce our dangerous dependence upon imported petroleum, but when you take a look at the budget recommendations that the administration has generated, I think one is forced to conclude that what has been submitted is simply an ideological document that is totally irrelevant to our Nation's needs to reduce oil imports.

In 1980 the direct use of oil accounted for 40 percent of the Nation's total energy consumption, while the use of electricity accounted only for 9 percent of our energy consumption. According to the Department of Energy's own projections, electricity will only provide 11 percent of the Nation's energy in 1990 and only 12 percent in the year 2000.

Despite that, and this is what emerges on the tables in question, the President's fiscal year 1982 budget proposal provided 76 percent of the Department's energy research and development funding for technologies which produce electricity, and only 9 percent of the Nation's current oil consumption is used to generate electricity, less than that now, closer to 7 percent.

However, only 24 percent of the fiscal 1982 budget proposal was dedicated to promoting fuel technologies and energy conservation.

Those are the figures that related to the President's 1982 budget proposal. Your proposed reductions in the energy conservation program would only further distort the priorities of the energy research and development program.

The Department's Energy Research and Advisory Board, with Mr. Roddis as chairman, came to the following conclusions, and I quote:

> There is a very heavy stress on electrical technology in fiscal year 1981, further accented in fiscal year 1982, although it is noted that fluid fuels consitutute our principal vulnerability.
>
> Similarly, within electricity, federally-sponsored nuclear programs are receiving a larger proportion of funding than the expected nuclear share of the U.S. energy mix during the next few decades.
>
> Finally, conservation, a very small fraction of the energy R. & D. budget in fiscal year 1981, is further and drastically reduced in fiscal year 1982, although it has so far contributed much more than supply augmentations in reducing our dependence on insecure oil imports.

Those are all quotes from the ERAB report. Mr. Davis, you have totally ignored the advice of your own Energy Research Advisory Board, and your proposed fiscal year 1983 budget recommends a 94-percent reduction in energy conservation R. & D. from fiscal year 1981.

Why have you chosen to ignore the advice of your Advisory Board by proposing to practically eliminate the R. & D. program for energy conservation?

Mr. DAVIS. The production of electricity last year consumed more than one-third of all the energy used in this country.

You are looking at the direct output, not the input.

Mr. WOLPE. Are you challenging the proposition that more than 9 percent, I think it may be actually closer to 7 percent, of all the petroleum that we consume in this country goes for the generation of electricity?

Mr. DAVIS. I was speaking to the point that electricity is a much larger fraction of our energy use.

Mr. WOLPE. The issue is how are we using petroleum. Is that not the key energy issue that we are facing, dependence upon that?

Mr. DAVIS. That is one of the issues. Conservation, primarily driven by price, has reduced our oil imports to something over 9½ million barrels per day, and it seems to be stabilizing at levels something like that. That is perhaps higher than we would like to have but we do see some marked effects of this on worldwide oil prices and the availability of lower priced oil.

I would like to reduce that to a lower level. It is certainly one of the pressing issues at the moment but not the most pressing. As far as conservation goes, the principal driving force for conservation has simply been the higher prices.

The economists have told us for many years that if you increase the prices, the consumption will go down; and, in fact, that has been what has happened. I think it is quite clear. We are trying to focus the conservation work that we are doing on those things which might contribute to the technology which will lead to further conservation.

We have dropped in our program or in our budget those things which are direct subsidies to basically bring about conservation.

Mr. WOLPE. I assume that there is some broad criterion that you are using in determining where scarce Federal dollars are being invested, but I submit that it has been argued that the key concern of this country is to try to reduce our dependence on imported petroleum.

Which technologies will most quickly and cheaply displace that petroleum dependence? If you are telling me that you dispute that criterion, let's get that upfront. I would be interested in knowing what other criterion you are employing.

Mr. DAVIS. I am not clear what criterion you are speaking of now.

Mr. WOLPE. How do you make your decisions to, for example, continue to invest in the Clinch River Breeder Reactor program?

Mr. DAVIS. We visualize that as one of the more certain long-term energy resources in this country.

Mr. WOLPE. Why, if electricity is not our requirement? If indeed we have an overabundance of electricity capacity, and the estimate is 30 to 40 percent on a national basis, why should we increase those kinds of dollars in a project that is so questionable on its face?

Mr. DAVIS. If you would let me go back to the statement I started with, I pointed out that a third of the energy used in this country is used to produce electric power. Further, we expect probably if the trend continues—and we see no reason to not expect it to continue—that this will be approaching something like 45 to 50 percent by the end of this century. We will probably be using half of all of the energy we consume in this country in the form of input into our electric generation.

Now that, I submit, is a very important thing and is probably as important as trying to reduce our imports to some magic level.

Mr. WOLPE. What I heard from you just is an assertion that you simply don't take as valid the conclusions of the ERAB. The whole thrust of their analysis, and I can quote you lots of segments of the report, is that there is an excessive concentration on electricity

generation in comparison with other priorities that they feel need ought to be attended to to a greater degree.

I hope at some point you would at least offer to this committee the basis for your refutation. What do you feel is invalid about the report?

One last question, and that is, what is the updated cost of CRBR?

First of all, Mr. Roddis, I understand that you were a dissenter on the Clinch River issue but, for the record, my understanding is that 17 of the 21 members actually voted to delay the Clinch River Breeder demonstration project; is that correct?

Mr. RODDIS. Yes, correct.

Mr. WOLPE. What is the updated cost? We have been using figures that were generated over 1 year ago as we discuss this issue.

Can either of you give a cost estimate updated?

Mr. DAVIS. In the order of $3 billion, that order.

Mr. WOLPE. It was $3.2 billion last year——

Mr. DAVIS. On the order of $3 billion. I don't have the precise numbers.

Mr. WOLPE. OK. Would you care to respond, what is it about this report that you find objectionable?

Mr. DAVIS. You have alleged that the report has been irrelevant to our decisions, and that the ERAB does not feel what they are doing may be worthwhile. I would submit that we have taken the ERAB reports and their comments very seriously. I happen to know personally many members of the committee and value their opinions, their objectivity and their experience very highly, and certainly I am not going to dismiss in any way their comments.

On the other hand, we have to make our own decisions, and ERAB is an advisory committee.

It is one of several different ways in which we get input, and the fact that we do not agree with everything that is in that report, even though we have accepted a good part of it, does not mean that we regard their work lightly, or that we are not taking it seriously.

If you want to get the feeling of the committee or its chairman, you should ask Mr. Roddis about what he thinks about the receptivity that the Department has to his work.

Mr. RODDIS. May I comment?

Mr. WOLPE. Surely.

Mr. RODDIS. Clearly, I am not discouraged. We have not discussed that en masse. I think I know all of the members well enough to say that they would not have the high rate of attendance and interest in what is going on, both in the panels and in the main board, if they were discouraged. We might well have liked to have had more of our recommendations accepted, but there are a lot of other inputs to the process.

Mr. WOLPE. Are you saying that the energy budget that has been offered this committee is an accurate reflection of the priorities recommended by the ERAB committee, Mr. Roddis?

Mr. RODDIS. The 1983 budget, sir?

Mr. WOLPE. Yes.

Mr. RODDIS. We have not had a meeting since the 1983 budget was released, so I cannot comment on what ERAB's view is of the 1983 budget. There is no way I can do that.

Mr. WOLPE. Thank you.

Mr. FUQUA. Mr. Skeen?

Mr. SKEEN. I would like to make a unanimous consent request that Mr. Fish's statement be included in the record.

Mr. FUQUA. It is already included.

Mr. SKEEN. Mr. Roddis, it appears that the ERAB report was issued too late to have an effective impact on the budget request. Since the future role of the national laboratories will be discussed as a part of the proposed DOE reorganization, it would seem important that such a report on the national laboratories be available early enough. You mentioned the final report will be available in September. This may also be too late to be useful, so when will a draft of the report be available?

Mr. RODDIS. A preliminary report is being discussed by the panel next week and will be in front of ERAB at its meeting the first week in April.

It will, of course, then be in the public domain, since both meetings are open to the public.

I expect to be able to get action on the preliminary report, at the April 8 and 9 ERAB meeting. There is a lot of additional detail required. The original charge to us was to have a preliminary report on March 1. We are not going to make that date. A final report is due on September 1 or 30, I have forgotten which, but we plan to meet that deadline.

Mr. SKEEN. It will be available in September?

Mr. RODDIS. Yes, sir; the final report.

Mr. SKEEN. I would like to ask you or Mr. Davis this question. In looking over the report under Fuel Supply, one of the higher priorities is enhanced oil recovery. In fiscal year 1982, the request is $20.1 million and for fiscal year 1983, $16.1 million.

Where is this allocation being made? Is it in any specific area, or across the board, or research grants, or what?

Mr. RODDIS. If I recall correctly, sir, our recommendation was that this was a high priority area, but one that required less funding than the $20 million of the fiscal 1982 request. People who are doing it are quite able to handle it themselves.

Mr. SKEEN. That is why I am asking the question, because I know that the private sector has taken over a lot of the R. & D. function in enhanced oil recovery, and I was just curious where the $16.1 million is going. I thought maybe these were possibly individual research grants or something of that kind.

I was trying to fathom your rationale and the criteria you used in doing this kind of work when there is already so much involvement by the private sector.

Mr. RODDIS. There are some areas, and I am afraid I can't go beyond what is in the book in that particular item, where we clearly felt that less should be spent. There is some work going on using the deep hole drilling techniques from the weapons laboratories. Small amounts of funding have been helpful to convert that work into something that could be used by industry.

Something less than $20.1 million in the fiscal 1982 request was clearly in order.

Mr. DAVIS. Mr. Skeen, we can supply you with that information.

Mr. SKEEN. I would like to have that for my information. It is very critical in our part of the world. I know that there is an awful

lot of private sector involvement in this area which has been one of the most productive R. & D. efforts taken over by private enterprise.

Mr. DAVIS. The private investment in enhanced oil recovery is many, many times what is shown here in our budget, and in cutting it back we have tried to focus on some of the basic scientific work.

Mr. SKEEN. Why couldn't we eliminate it altogether?

Mr. DAVIS. There are still considered to be some areas in which some R. & D. would be valuable and profitable but you recognize that the industry is doing by far the largest part of the work.

Mr. SKEEN. Thank you, Madam Chairman.

Mrs. BOUQUARD. Thank you, Mr. Skeen.

Mr. Ottinger?

Mr. OTTINGER. In looking at the 1981 and 1982 budgets, deciding where the emphasis ought to be placed, your principal conclusions are on page 14, where you conclude that there is too much emphasis on electricity technology, and in 1981 and further accented in 1982, within electricity too much nuclear, and finally, that conservation efforts are cut too drastically.

Those were the principal overall assessments of the program.

Mr. RODDIS. Sir, there was one other conclusion of significance in that we recommended a substantial increase in the Federal efforts in the acid rain and CO_2 problems because of their impact on the use of coal, and for that matter on the use of oil, too.

Mr. OTTINGER. Well, then, it seems to me that you have expressed yourself already with respect to a 1983 budget that puts much more accent on electricity; that takes the nuclear portion of the budget up to 86 percent and cuts conservation by 97 percent from what it was. So while you have not specifically addressed the 1983 budget, the 1983 budget would certainly seem to be completely inconsistent with your recommendations as they pertain to 1981 and 1982.

Mr. RODDIS. Sir, as the spokesman for ERAB, I can't comment on that. We did not see the 1983 budget until after our last meeting, so it will not be until the April meeting that we can talk about the subject.

Mr. OTTINGER. Your 1982 conclusions stand, however?

Mr. RODDIS. Of course, sir.

Mr. OTTINGER. The things in the budget that makes those things worse are not consistent with your recommendations. If the 1983 budget in fact puts more accent on electricity and more accent on nuclear and eliminates conservation, isn't this inconsistent with your recommendations made in 1982?

Mr. RODDIS. I don't disagree with your conclusion. I can't express that as a conclusion of ERAB because we have not met.

Mr. OTTINGER. Your conclusions, based on 1981 and 1982, are that the emphases are misplaced. In fact, the 1983 budget is further misplaced along with those recommendations, and I assume a budget which made those things worse would not be in accordance with the ERAB recommendation, is that fair?

Mr. RODDIS. You are reaching a conclusion of fact. As an individual, I agree with you personally. I can't express the feeling of ERAB.

Mr. OTTINGER. Based on what you did in 1981 and 1982 where ERAB has expressed itself?

Mr. RODDIS. Sir, I can only say that I have expressed what our action was, based on the timeframe.

Mr. OTTINGER. You leave it to me to say that the 1983 budget makes things worse.

Mr. Davis, I was just intrigued by your description of how you make your decisions, because it really gets to the crux of, I think, our concerns in many areas. It does not sound as if you make any systematic attempt to study what is in the greatest advantage of the country or set forth in a criterion. You said you applied your philosophic preferences to the various items in the budget and made hard choices and tossed that up to OMB and they exercised the same kind of subjective judgment and we are left with what we have got.

Don't you think in a matter as important as energy in the country that there ought to be some criteria established, some priorities? For example, either it is a priority or it is not a priority to reduce the imported oil.

I find it terribly disturbing that there seems to be a complete absence of objectivity in approaching these critical problems to the country.

I also find it very, very difficult that you can shrug off the importance of reducing imported oil, when the vulnerability to a supply interruption in the Middle East is so great and could jeopardize the national security of the country, and when we paid out some $70-plus billion last year for imported oil, even though the imports were less than before.

Mr. DAVIS. Well, Mr. Ottinger, I did not say that we were shrugging off the problem of imported oil.

What I said was, as the level has been reduced sharply, it is still one of our important priorities but we have some other priorities, too. In terms of what we are seeking to accomplish, we are trying to increase the use of coal, both directly and by conversion to other more readily usable things in terms of gas and like industries. We are trying to stimulate, by various kinds of actions, increased exploration for oil and gas. We are trying to develop further a base for an increased use of electric energy in the future. I have tried to put that in perspective as one of our present major uses and an increasing one.

We are trying to establish, and do have, a basic approach to all of this. It is not something that is done in a vacuum at all.

Mr. OTTINGER. On what basis is it done? People do need coal, electricity, and they need to be able to run their cars, heat and cool their houses, and one would think an objective look to see what it takes to keep this society moving, where the shortages are, both nationally and internationally and how we go about in the most cost-effective way of being able to address those.

Everyone who has done that, starting with the Ford Foundation, the Carnegie Mellon Foundation, et cetera, has come to a conclusion that the best way we go to getting supply and demand in this country in terms of balance, in terms of least cost, is conservation.

The ERAB report says the same thing, and it seems to me that the Department of Energy and OMB just for some reason shrug all

of that aside and say, well, that may be what all the studies show but we think something different.

Mr. DAVIS. I don't believe that that is a fair conclusion. What we have observed is a very large amount of conservation.

Mr. OTTINGER. The economy is in shambles. The whole free world is down.

Mr. DAVIS. The economic climate certainly has something to do with it, but we also believe that a very large part of that is not due to the recession but due to the increase in price. That would seem to be unavoidable.

Mr. OTTINGER. Conservation improvements are going to be able to produce additional supplies to meet the demands out there through efficiencies at a far cheaper cost, and——

Mr. DAVIS. Mr. Ottinger, I think this is the point. We see very clearly that the increases in prices not only are decreasing use directly but are leading people to buy smaller cars, more fuel-efficient cars, and we don't have to subsidize that. It is causing people who own factories, businesses, to put in more energy-efficient equipment and they are doing it.

Mr. OTTINGER. In order to be able to alleviate oil imports, that would lead one to the conclusion that maybe what we ought to do is double the price of oil again. Is that the Department's position?

Mr. DAVIS. That is not the Department's position.

Mr. OTTINGER. Where does the Department go from here?

Mr. DAVIS. We are seeking to let the market make the kinds of changes that we have talked about and support some of the kinds of research and development as such, which may lead to future improvements in people being able to conserve further.

What we are not doing is proposing to continue those programs where we were essentially subidizing the conversions, things of that sort. That is a basic difference in philosophy of this administration compared to the last, and that is the difference.

Mr. OTTINGER. That is all fine, but it seems to me that it ought to be backed up by something. There was a difference in philosophy on supply-side economics, and nobody did the studying, as Mr. Stockman indicated. Taxes were cut willy-nilly, and defense was increased willy-nilly and now we are faced with a $100 billion deficit because nobody did their homework.

There are no studies in your Department to show in fact your program will help alleviate our dependence on imported oil faster, more efficiently, at less cost, with less environmental damage than putting the same kind of money into conservation. It seems to me it is done on the basis of philosophy and that is an improper way. No business would approach its decisions in that way. Bechtel wouldn't do that, Mr. Davis. If you had come in and said I think we ought to reverse our corporate investment because I believe this and that, they tell you, well, go make a study and see if it would happen wouldn't they?

Mr. DAVIS. There have been a very large number of studies of all sorts, some of which I have participated in, in the past. I don't quite understand why consistent philosophy is not a good starting place for your planning. That is what we have been seeing to utilize as a base and then develop it further into the plans.

Mr. OTTINGER. You might convert me to your philosophy if you showed me in some objective way that it has a chance of working, but all you are telling me is believe me. All you are telling me is, we believe that electricity is going to play this huge role in the future, when in fact electricity use is declining.

Mr. DAVIS. I am sorry; electricity use is increasing, sir.

Mr. OTTINGER. Well, the electricity use is increasing at a much slower rate.

Mr. DAVIS. Not as rapidly as it did for a period of 20 years, but it is still increasing substantially.

Mr. OTTINGER. That avoids the thing that I am concerned about, and that is the philosophic bet of the administration and the Department of Energy that ought to be put to the test of some kind of objective analysis. If you put so much money here, what kind of payback do you get? What are the risks and benefits?

All our regulations are being subjected to very heavy cost/benefit analysis, and the administration is at the forefront of that. Why isn't the research dollar submitted to cost/benefit analysis?

Mr. DAVIS. In each of the individual programs, in effect it is. I don't know that we made an overall study that says that the whole program collectively has ever been looked at in quite that broad a sense.

Mr. OTTINGER. Don't you think it should be?

Mr. DAVIS. We have tried to do that in a broad way in our national energy policy plan. That is about as close to a comprehensive evaluation that we have produced. That has really been the starting point for our actions during the subsequent months.

Mr. OTTINGER. That was a statement of your philosophies.

Mr. DAVIS. Backed up by a considerable amount of analytical work or various facets of it.

Mrs. BOUQUARD. The time of the gentleman is exhausted.

Mrs. SCHNEIDER. Not only is it exhausted; I would like to say it feels like I have been part of a bad nightmare for 2 days running because the Department of Energy has been testifying before various committees on which I sit. It has been extremely frustrating to listen to the testimony, and particularly the comments raised by Mr. Ottinger. You are saying there is a difference of philosophy in terms of energy emphasis. Granted, your philosophy focuses on market changes, letting the market determine what energy policy we have, is that correct?

Mr. DAVIS. The policy is to make the maximum practical use of free market forces to bring about those changes that seem to be desirable.

Mrs. SCHNEIDER. I can appreciate that, but you must understand that your proposals lack total credibility. By your stating this philosophy, it is so transparent, translated into budget priorities, when you say we will let the market make the determination, and yet at the same time just out of the other side of the Department of Energy, we are saying we will subsidize the Clinch River breeder reactor for the nuclear industry.

There is no credibility there whatsoever. I am most interested in this budget process in equity and there is no equitable determination of how these funds should be spent, and there is no consistent philosophy whatsoever. I feel like I am being repetitious, but if you

had been with me all through yesterday and today, all of my other colleagues were essentially saying the same thing. I am afraid the Department of Energy lacks total credibility right now.

Mr. DAVIS. You are certainly entitled to your opinion.

I would point out, both I and Mr. Roddis have said that we have to look at the various segments of the energy business in somewhat different ways when we are looking at what we will support in terms of R. & D. Certainly when one focuses, as you do, on those parts which relate to the electric utility industry, we must recognize that, both historically and at the present time, industry is a completely regulated industry which has today inadequate revenues.

Mrs. SCHNEIDER. We are not talking about regulating. You mentioned people are buying more fuel-efficient cars, and factories are investing in energy equipment to conserve, that there is a market movement that is looking toward conservation.

Yes; that is quite true, but I will also point out that most of those fuel-efficient cars that are being purchased happen to be foreign cars.

The research to make the 90-mile-per-gallon car has been done by Volkswagen, and they will have that on the market in 3 years, while we are struggling here in the United States to get up to 30 miles a gallon. This is talking about research in terms of energy. Also talking about energy equipment, the Department of Energy has recommended that we eliminate the small-business tax credits.

If we eliminate that and funding for research into technological fixes that will improve energy efficiency, then that is not really a free market approach, now is it?

Mr. DAVIS. Eliminating tax credits is not a free market approach?

Mrs. SCHNEIDER. Cutting back on the budget so far as research and development in business and industrial conservation is concerned, coupled with eliminating the tax credits. When you look at where you are cutting and where you are allowing money to be spent, it seems that the axe is being put on conservation. And you say, well, let the free market take its course. You are creating a disadvantage.

Mr. DAVIS. Our perception is that the free market is able to deal with that area effectively.

Mrs. SCHNEIDER. I am sorry, sir.

Mr. DAVIS. Our perception is that the free market is able to and is dealing with that area effectively.

Mrs. SCHNEIDER. But it is not. How can you say that you are taking the free market approach except for the Clinch River breeder reactor?

Mr. DAVIS. It is not simply except for the Clinch River breeder reactor.

Mrs. SCHNEIDER. Or the nuclear industry.

Mr. DAVIS. We are not subsidizing the nuclear industry.

Mrs. SCHNEIDER. Our research budget, 27 percent is going into the CRBR. Now, are we going to give 27 also to the fossil fuel industry, synfuel, to solar, hydro, and conservation? No; and then we shouldn't give any of those different energy technologies any support whatsoever. What is fair for one is fair for another.

Mr. DAVIS. The circumstances in each are quite different and we feel that justifies treating them differently. That is a matter of opinion. Our opinion is that if we did not do this, there would be no way in which those industries, which are heavily regulated, which have no revenues, no extra revenues to support their R. & D., would be able to carry it out. For the long range, very large programs that are necessary to insure the future, it is part of our responsibility to do that research.

Now, that is a matter of opinion. That is our opinion.

Mrs. SCHNEIDER. In response to Mr. Ottinger's question, Mr. Davis, you said the Department does cost/benefit analysis on individual programs. Isn't it a fact that the Department decided not to update its analysis of the breeder program in the Department's recent supplemental environmental impact statement on this particular program?

Mr. DAVIS. I don't believe we found it necessary to update it.

Mrs. SCHNEIDER. Is this because the Department recognized that the breeder program can no longer withstand a comprehensive cost/benefit test?

Mr. DAVIS. Not in anyway.

Mrs. SCHNEIDER. Many other studies seem to indicate it cannot withstand that kind of cost/benefit analysis. We are looking for consistency and balance, and this is one of our great frustrations.

Mr. DAVIS. There are other studies that do show that it can.

Mrs. SCHNEIDER. Another frustration that many of us share is that Mr. Roddis and his group put together a study, which I guess we the taxpayers have paid for, and there are numerous other studies that have been put together. I guess I just wish to go on record as showing my frustration in seeing that your decisionmaking process does not involve cost/benefit analysis or any studies as to supply and demand and priority setting.

I think the effect of the plan of the Federal conservation and solar budget will be to place the United States at the bottom of the international league when it comes to talking about our competitive capabilities. In numerous international studies it has become very clear that other countries, particularly France, Sweden, and Japan, are placing increased emphasis on their conservation and renewable energy budgets. Here we are in this country, where our one advantage in trade is the high technology in these areas, and we are willing to give up that edge.

Mr. DAVIS. I would also point out that France and Japan in particular are increasing their nuclear budgets in their support of the breeder.

Mrs. SCHNEIDER. This conclusion about our technological edge in the international arena, as it refers to conservation and solar, is from the DOE study done by DHR. I think that, once again, this is a study that is prepared for you, but I am not sure that you have incorporated it into your decisionmaking process.

You mention how other countries are moving ahead in the nuclear option. I have some serious questions.

Mr. Roddis, you had mentioned at a meeting that we had earlier with the cooperation of Congressman Fish, that, as one of the dissenting voices in the Clinch River breeder reactor program, one of

your concerns was that we might lose our international edge insofar as breeder technology is concerned.

I think that one of the points that I made was, how is it that we are so concerned about losing the edge there when it is quite clear that our photovoltaic capability will be purchased very shortly from Japan?

Once again, there is this inconsistenty. It is all right to lose our technological edge on all energy technologies except for the Clinch River breeder reactor project.

Can you comment on that?

Mr. RODDIS. Certainly, the ERAB position could not be interpreted as saying we want to lose our technological edge in any area.

Mrs. SCHNEIDER. It seems to me the Department of Energy ought to pick up on your comments on photovoltaics that are included in the ERAB report because it is quite clear that the decrease in cost of photovoltaics will slow down if we go along with their budget and this, in turn, will increase the opportunities for foreign manufacturers to dominate the technological scene in that area.

Did you want to make a comment, Mr. Davis?

Mr. DAVIS. We certainly are not dropping photovoltaic development. There is $27 million in the fiscal 1983 budget.

Mrs. SCHNEIDER. I am talking about equity, balance, and consistency in your philosophy. There does not appear to be any. You can't comment on why you think it is all right for us to lose our technological edge on photovoltaics but not over CRBR.

Mr. DAVIS. I do not believe that we are losing our technological edge. That is an assertion that I would not agree with.

Mrs. SCHNEIDER. How much has our photovoltaic budget been cut since 1980?

Mr. DAVIS. I am afraid I don't have those numbers, and I am not sure that is the primary measure.

Mrs. SCHNEIDER. I think one measures priorities as to how much money one is throwing at those projects, or how much one is cutting from those projects.

Mr. DAVIS. Well, I would submit that throwing money at research and development projects does not guarantee their solution.

Mrs. SCHNEIDER. That has been quite evident and it has been proven when one looks at the CRBR project after all these years.

I have no further questions except one.

Whom do you see your primary responsibility to? Who do you feel that you are most supposed to be answering to?

Mr. DAVIS. You mean in an organizational or philosophical sense?

Mrs. SCHNEIDER. Both. I would hope they would coincide.

Mr. DAVIS. I work for the Secretary of Energy and I am sure our responsibility is to the American people to develop and carry out the best program we can. That is what we are trying to do.

Mrs. SCHNEIDER. The most cost-effective or efficient program?

Mr. DAVIS. That is one way to look at it, but not necessarily the only definition, because there are some other things such as national security and things in the long-term future that are very difficult to assess strictly from a cost-efficient point of view.

Mrs. SCHNEIDER. If you are to reflect the desires of the American people, there are numerous polls done nationwide that will show

you what prioriites the American people choose for energy, and I would recommend that if you are going to ignore the ERAB report, ignore the comments of this committee and ignore many of the numerous other reports that have been slated today, then perhaps you ought to look at the Harris polls and some of the other polls that clearly indicate what direction the American people prefer.

Mr. DAVIS. We are not ignoring anybody. On the other hand, it would be impossible to accede to everybody's recommendations.

Mrs. SCHNEIDER. They are all speaking in one voice except for the Department of Energy.

Mr. DAVIS. I don't agree with that.

Mrs. SCHNEIDER. Thank you, Mr. Chairman.

Mr. FUQUA. Mrs. Bouquard.

Mrs. BOUQUARD. I don't believe I heard an answer to Mrs. Schneider's question. Why do utility regulations affect the Federal R. & D. budget?

Mr. DAVIS. I was seeking to point out, as I think both Mr. Roddis and I have observed, that there are clearly differences between the oil companies, who are not regulated, who are able to generate internal funds and to borrow money without great difficulty, who are able to finance very large exploration and development projects from those funds, and other types of research and development work.

We have in the electric utility industry today nationwide—it varies from State to State—a situation which has continued for several years and, as far as we can see, will continue for some time into the future, where they are faced not only with high rates of inflation on their projects, but very high interest costs. In general, they are having to face something like perhaps 17 or 18 percent to borrow money and are allowed a theoretical rate of return of 14 or 15, although the actual rates give them 12 percent overall average. The result is that the utilities are unable to do more than to pay their current costs for fuel to keep their people on the payroll and sort of keep the business running.

When it comes to investing any significant amounts of money into research and development or into building new facilities, they simply don't have funds to put into it. If they were unregulated, and could go out and raise money, it would be different, but the electricity and gas utility industries are highly regulated, and they are getting inadequate revenues to keep their present businesses going, much less to finance large, expensive R. & D. projects and facilities.

And, in combination with this, the electric utility industry is probably the most capital-intensive industry that we have in terms of any new investments. So that is the situation which seems to dictate, and continues to justify our, at least, taking on the task of trying to develop the long-range type of facilities that may be needed in 30 years, such as the fusion program, the breeder program and other things of that size and of that long-term nature.

Mrs. BOUQUARD. Mr. Chairman, I ask permission that members be able to submit written questions to our distinguished panel today.

Thank you, Mr. Chairman.

Mr. FUQUA. We may have some additional questions.

Mrs. SCHNEIDER. Mr. Chairman, may I please raise a point for clarification?

Mr. FUQUA. Certainly.

Mrs. SCHNEIDER. You are stating, Mr. Davis, if I understand this correctly now, that the utilities as a group have a more difficult time in their investments for R. & D. development. Is that correct?

Mr. DAVIS. The ERAB report indicates that conservation should be a priority, and that they have a difficult time in furthering the advancement of energy efficiency technology because they do not have any kind of a cohesive entity for research and development.

Is that not true, Mr. Roddis?

Mr. RODDIS. The comment was made about the fragmentation of the building industry specifically, yes.

Mrs. SCHNEIDER. Well, I think once again we have a major inequity here in a situation where the Electric Power Research Institute has in their R. & D. budget $300 million, whereas, for energy conservation R. & D., which is a totally dispersed entity, they have no access to capital.

That is all I wanted to say, Mr. Chairman.

Thank you.

Mr. FUQUA. Thank you, Mrs. Schneider.

I want to thank you, Mr. Davis and Mr. Roddis, for being here this morning.

I think you can tell by some of the comments and questions that have been raised that there is a great deal of concern about the budget and the imbalance that it has in various forms. We are very much concerned about that, and we will be dealing with that subject as we move further into the budget during the course of our authorization hearings.

I thank both of you for being very patient and for being with us here this morning.

[The report of the Federal Energy R. & D. priorities of the Energy Research Advisory Board follows:]

Department of Energy
Washington, D.C. 20585

December 4, 1981

Honorable W. Kenneth Davis
Deputy Secretary of Energy
1000 Independence Avenue, SW
Washington, DC 20585

Dear Ken:

I am pleased to forward the Report of the Energy Research Advisory Board on Federal Energy RD&D Priorities. This report was prepared in response to your request on August 13, 1981, to review the relative merits of each major R&D program.

The Board is in full agreement that the Federal Government must continue to support research and development for the technologies upon which the nation's energy future depends. Although all the members (except for Philip Handler) participated in the development of this report and reached a consensus on most recommendations, there are a few statements that represent majority opinions where every member did not agree to every statement. Dissenting views on those recommendations for which overall agreement was not possible are included in the Appendices.

Sincerely,

Louis H. Roddis, Jr.
Chairman
Energy Research Advisory Board

Enclosure

cc:
Thomas J. Kuehn, ERAB
Joel Snow, ER-4

Department of Energy
Washington, D.C. 20585

December 4, 1981

Louis H. Roddis, Chairman
Energy Research Advisory Board
110 Broad Street
Charleston, SC 29401

SUBJECT: Letter of Transmittal of the R&D Panel RD&D Priorities Report

Dear Lou:

This letter transmits to you the RD&D Priorities Report. The report contains inputs from all members of the Board, and except where minority views are presented, there is general agreement with its contents.

As you know, the methodology required members of the Panel to evaluate each R&D program in terms of a specific set of criteria. The evaluations were combined to arrive at composite figures of merit which were then reviewed and discussed by the R&D Panel. At the outset of this project, there was some uneasiness about the validity of the evaluation methodology. To guard against possible difficulties, each section of the report, after drafting by two members of the Panel, was reviewed and discussed thoroughly by the full Panel before final judgments were made.

I believe that the evaluation methodology worked quite well. It provided assurance that the key criteria were explicitly considered, and this helped us identify quickly the sources of agreement and disagreement. The second stage of the process provided for resolution of the areas of disagreement. Where necessary, members of the Board voted to arrive at final recommendations. You offered the opportunity to members to advance minority views, and such views are included in the final report.

The preparation of this report in such a short time was a formidable task. In my view, the Board did remarkably well to complete this study on time.

Sincerely,

John S. Foster, Jr.
R&D Panel Chairman

Federal Energy R&D Priorities

REPORT OF THE ENERGY RESEARCH ADVISORY BOARD

November 1981

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November 1981

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November 1981

FEDERAL ENERGY RD&D PRIORITIES

I. EXECUTIVE SUMMARY

Background

In a letter dated August 13, 1981, the Deputy Secretary of Energy asked for the advice of the Energy Research Advisory Board (ERAB) on DOE's R&D priorities and on "hard choices" the Department must soon make as to "which programs to pursue vigorously and which to de-emphasize based on a realistic appraisal of both our energy options and energy needs for the foreseeable future." This report of ERAB responds to that request in the context of continuing pressure for further reductions in DOE's budget. This report presents recommendations on priorities within DOE's non-defense R&D program and suggests where funding should be changed, either increased or decreased relative to the President's FY 82 budget request.

During the last year, major changes in policy have been made; these have already led to changes in DOE's objectives, strategies, R&D funding and internal allocations of R&D funds. In carrying out its study of DOE's R&D priorities, the ERAB has generally accepted these new policies and has confined its recommendations to matters of science, technology and engineering. In some areas, however, particularly in electric supply and conservation, the ERAB's application of these policies has resulted in somewhat different conclusions than those reflected in the President's FY82 budget. Moreover, the application of these policies has led to recommendations by the ERAB that differ significantly from those it made to the Secretary of Energy on September 5, 1980 in the interim report on research and development needs in which the Board applied funding policies of the previous administration.

Recommendations of this study resulted from application of both a new assessment methodology developed by the R&D Panel of ERAB and more conventional and traditional evaluation techniques. The new methodology required Board members to evaluate each R&D program in terms of a specific set of well defined criteria. This insured that each program was evaluated comprehensively by each member. The evaluations of all R&D Panel members were then combined numerically. These composite evaluations were then used as the basis for more traditional judgments, discussions and consensus building, leading to conclusions and recommendations by the Board. The salient findings of the Board are:

- Funding relative to the President's FY82 budget request for the science and technology base programs should be increased in some programs and remain the same in others. Within these programs high priority should be given to:

- research on the phenomena governing accumulation of CO_2 in the atmosphere from combustion of fossil fuels, climatic effects of this accumulation, tolerable levels of CO_2 and ways to control CO_2 accumulations

- research into acid rain, its causes, effects and control technologies

- In the electric supply sector, priority should be given to supporting:

  - nuclear waste isolation research and demonstration
  - conventional reactor systems and safety
  - the LMFBR base program
  - uranium enrichment R&D

- Programs in which reductions can be made include:

  - small reductions in magnetic fusion

  - significant reductions in the Clinch River breeder,* the light water breeder, electricity transmission, and high temperature geothermal

  - phase-out of funding for hydropower and magnetohydrodynamics

- The Board noted that the electric supply technology is receiving a fraction of DOE's funding that is substantially in excess of its contribution to present and future energy supplies.

- In fuels supply technologies, the Board believes that technologies such as enhanced oil and gas recovery, while urgent because of near term benefits, will be adequately supported by the private sector. DOE's support of these programs can thus be reduced. The Board also recommends that:

  - the major Federal effort in synthetic fuels research and development be directed at innovative concepts at the laboratory and small pilot-plant scale. In view of the financial guarantees available from DOE and the Synfuels Corporation, DOE's budget for cost-shared projects at the large pilot plant and demonstration-plant scale and for in situ shale recovery should be reduced.

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*See dissenting opinion and additional remarks in Appendix D.

- the funding level for R&D directed at producing liquids and gases from biomass and the production of alcohol is at an appropriate level.

- ERAB urges that the parts of Advanced Research and Environmental Control Technology R&D (FE) concerned with technologies to control SO_x, NO_x and particulates emissions be increased and strengthened at the expense of other activities in this program.

- On an overall basis within the Department of Energy, R&D funding for energy conservation and end-use technology is underfunded, particularly when compared with funding levels for supply technologies. A balance that better reflects the opportunities, importance, and nature of the Federal role in supporting private sector response needs to be achieved. This should be achieved by increases in funds allocated to buildings and community systems and industrial conservation.

- The Board believes that if its recommendations are implemented, a net reduction in DOE's budget will result.

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II. INTRODUCTION

A. Background and Purpose

On April 30, 1980, the Deputy Secretary of Energy* requested that the Energy Research Advisory Board (ERAB) participate in the Department's review of the technology base component of its R&D programs by addressing the following concerns:

- The adequacy of the research underpinning for technology development programs
- Possible gaps or duplications of effort
- The balance among research performers in the universities, laboratories, and industry
- Significant R&D opportunities that our programs may be missing.

As a result of more than 16 public meetings during July and August 1980, a report was prepared by an R&D Panel and seven subpanels covering each of the major DOE program areas. This report titled, R&D Needs in the Department of Energy, was submitted to the Secretary of Energy on September 5, 1980, and recommended enhanced funding for a number of DOE program areas.

In the original request for an R&D study by ERAB, the Deputy Secretary expressed the view that this project should be a continuing effort through which ERAB would assist the Department in its R&D program evaluations. After the publication of the interim report, several members of the original panel continued to review various methodologies for evaluating R&D programs. On August 13, 1981, the Deputy Secretary* requested ERAB's recommendations on overall Federal energy R&D priorities specifically including the following concerns:

- The relative merits of each major R&D program with respect to such criteria as the technical and economic potential, urgency and lead time required, benefits and costs of Federal funding, contribution to energy security, health and environmental risks, and the appropriate Federal role;
- The appropriate R&D funding balance between electric power supply, fuels supply conservation, and technology base program areas;

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*See Appendix A.

- The appropriate program orientation and balance between research, development, and demonstration activities;

- The strategic R&D objectives for the near, mid, and long term.

In September 1981, the R&D Panel was restructured to include all members of ERAB who contributed individually to the evaluation of 49 program areas covering all energy R&D programs. The Panel met on September 24, 1981, to discuss the results of their evaluations (see Appendix B for details on methods and criteria) and to reach a consensus on its recommendations for R&D priorities. The R&D Executive Committee met on October 30, 1981, to revise the draft report before it was discussed and the body of the report approved by ERAB at its November 4-5, 1981 meeting.

In these times of budgetary restraints, it is imperative that maximum effectiveness be attained in the use of Federal R&D funds. It is essential that a rational basis for evaluating priorities and the proper balance of funding be used to allocate increasingly scarce fiscal resources. The purpose of this assessment is to provide the Secretary of Energy with ERAB's best advice toward the accomplishment of that goal. The ERAB devised a methodology for structuring the discussion of RD&D priorities and relative funding levels for energy RD&D. A brief description appears in section II.C.

B. Energy Policy Context of R&D: "The Federal Role".

Between our 1980 study and the present one a new Administration has re-defined the appropriate role of Federally-sponsored energy R&D. Differences in our conclusions and recommendations from the earlier study result to a considerable extent from this redefinition and our adherence to it -- with certain exceptions noted below.

The previous Administration defined an expansive role for Federally-sponsored R&D, including demonstration and commercialization. The new Administration, by contrast, proposes to:

- Drastically shift the emphasis from Federal sponsorship to reliance on the private sector. With few exceptions this includes total reliance on the private sector for demonstration and commercialization.

- Limit appropriate Federally-sponsored R&D to: 1) Basic energy science and technology base; 2) Energy R&D of a long-term high-risk character; and 3) Research on the health, safety, and environmental aspects of energy supply and use.

- Strive to reduce Federal expenditure and the Federal deficit.

ERAB's deliberations have reflected an expectation that Federal funds for R&D will be stringently limited for the foreseeable future. In evaluating R&D programs ERAB has conformed generally but not slavisnly to this policy. We applaud greater reliance on the private sector whenever possible. We applaud the restoration of a free market in petroleum. ERAB believes that much, perhaps most, of new energy supplies and greater efficiency in energy use will in fact be achieved by higher energy prices. But ERAB is concerned that some energy R&D of great potential significance for the achievement of the Nation's energy goals will fall between Federal and industry responsibilities.

The new policy recognizes that private industry cannot be expected to do basic energy research or projects of a long term, higher risk character. But there are other circumstances in which it would be unrealistic to expect timely and effective assumption by industry of R&D responsibilities abdicated by the Government, however worthy the projects involved, and despite the provision of new generous tax incentives. Some of these circumstances are discussed below.

Some of the markets on which energy is sold are not "free." Oil and coal are the exceptions. A little over half our primary energy finds its way to consumers through the electric and gas utilities, and the utilities are regulated, price-controlled industries, selling their products not at free market prices, but at controlled prices well below replacement cost. The consequences are that consumers of gas and electricity have less of an incentive to conserve (and therefore to undertake research on conservation) and that producers of electricity are so strapped financially that they cannot afford conventional additions to capacity, let alone demonstration projects or any expensive R&D. Gas producers are faring somewhat better and can look forward to eventual decontrol at the well head, but gas transmission and distribution will remain under control indefinitely and so presumably will the investor-owned electric utilities.

Both these regulated industries have weak incentives to spend on R&D. If successful, the benefits go to rate payers; if unsuccessful, the expenditure may be disallowed as "imprudent." In the case of electricity (but not gas) a substantial amount of R&D has been undertaken by large research-oriented equipment suppliers. And during the past decade the "invention" of a device for financing industry-wide R&D by rate payer levies through EPRI and GRI has enhanced the ability of both industries to respond to R&D needs and provided an alternative to some government-sponsored R&D, but the total annual budgets of the two institutions (less than $300M and $100M respectively) are far too small to permit them even to contemplate financing demonstration or first-of-a-kind commercial plants at a billion or more each.

Some energy related industries are too fragmented to organize and finance a strong R&D response to market signals. Individual units lack the financial strength, and realize too well that the benefits would accrue mainly to other units. Before the advent of agribusiness, the tremendous gains in agricultural productivity resulted from government and government-supported university research and an extension network to convey the results of the research to individual farmers. The building industry, to take an important example, is now similarly fragmented and similarly incapable of organizing and funding its own research.

Even where some larger units exist, industries with a strong R&D orientation and capability are the exception in America. Most of our industry-sponsored R&D is now highly concentrated in a few industries. The reasons may be historical, institutional, or adventitious. A strong R&D response to price signals requires both motivation and capability. In many cases the capability is simply lacking, and while it can be developed given time, the time required to build a strong research organization is measured in years.

A common reason for no response or inappropriate response by consumers to market signals is ignorance. EPA ratings of the fuel efficiency of automobiles, however faulty, focused attention on the potential savings and gave buyers useful guidance. The effect on the average fuel economy of new cars has been dramatic. In the case of buildings, particularly their heating and cooling, ignorance still reigns supreme. Almost no one knows what is cost effective at different prices, or where to go to get reliable, objective information. Almost no one knows how much reduced ventilation in super insulated buildings is safe or how to reconcile tightness and safety. The retrofit problems are extremely complex, and even the best "house doctors" are only beginning to learn their job. In the meantime we are consuming more energy in heating and cooling residential and commercial buildings than in running our automobiles, and the potential savings are also greater. The government can provide some of the research needed to achieve them.

To conclude: ERAB in its evaluations of programs has taken the new policies and guidelines relative to the Federal role very seriously, but ERAB has made exceptions where there is reasonable certainty that timely and adequate response by industry and commerce is an unrealistic assumption, and that continued Federal research support is therefore still required, at least for a time.*

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*We have not, in this report, responded to the Deputy Secretary's request for advice on the respective roles of industry, university, and national laboratory R&D efforts. This will be a major focus of our new study on DOE laboratories, initiated on November 3, 1981.

C. Methods and Criteria

This assessment features an evaluation technique in which each member of ERAB evaluated 49 program areas covering all DOE energy R&D programs in terms of seven criteria for energy supply and conservation programs and five criteria for science and technology base programs. Each member evaluated the relative importance of these criteria and judged whether more, less, or the same amounts of money relative to the President's request for FY 1982 should be allocated to the various programs. The judgments of the Panel members were combined numerically to arrive at figures of merit for each program on the relative priorities of energy technologies and whether financial allocations to each program should be increased, held the same, or decreased relative to the President's request for FY 1982. The resulting figure of merit was used to rank the programs in order of importance.

Criteria used in evaluating the priority of each technology were selected and the definitions for each criterion agreed upon. The criteria for the R&D programs were technology potential, urgency, economic potential, benefit/cost, energy/national security, health/safety/environment, and federal RD&D role. The criteria for the Science and Technology Base programs were scientific potential, risk/benefit, mission impact, urgency and federal role. A more detailed definition of these criteria is given in Appendix C.

Each member of ERAB determined the relative importance of each criterion and then judged its importance for each technology. From this information normalized weighting factors for the criteria were determined. Using these factors and the criteria/technology judgement information, figures of merit were calculated for each technology. Recommended funding levels for each technology were also provided by ERAB members. This information was used as the basis for discussing recommendations of future funding -- namely, whether the funding for each program should be decreased, remain the same or be increased relative to the President's FY82 budget request.

The results of this method allowed for a systematic, well structured debate on issues where the level of agreement was not clear or where clear disagreement was obvious. It was also quite effective in identifying areas of strong agreement by ERAB on a particular value judgment. It is important to note that the assessment or evaluation methodology which used decision questionnaires from each member was not intended to and did not "fix" the results of the final priority ratings. Rather the methodology was designed as an initial point of departure for discussion from which final conclusions would ultimately evolve -- conclusions that were not necessarily consistent with the initial ratings. Where reasonable consensus could not be reached, the expression of minority views is included.

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III. ENERGY PROSPECTS

A. Supply and Demand Projections

Table III-A shows the latest DOE projections* of U.S. energy consumption for 1990 and 2000 compared with actual consumption for 1980. Table III-B shows similar projections for U.S. energy production and net imports.

The most striking aspect of recent supply/demand projections has been the sharp drop, especially over the last two years, in the projections for total consumption of energy in the years 1990 and 2000. Figure III-1 illustrates the point. What lies behind this development are (1) a much stronger user response to rising energy prices than had been expected; i.e., greatly and steadily increasing efficiency in the use of energy, which has been expressed as a less than proportionate increase in energy consumption associated with a given increase in GDP, gross domestic product, (see Figure III-2), and (2) a substantial reduction in the expected rate of economic growth. This double-barreled assault on earlier projections has now reduced them to the equivalent of an annual growth between now and the year 2000 of about 1 Q/yr (equal to 0.5 MBD of oil, or 40-50 million tons of coal per year, or a trillion cubic feet of natural gas per year).

A second characteristic of energy consumption and production projections is that there remains a sizeable band of uncertainty. This is especially disconcerting where imported oil -- the country's Achilles heel -- is concerned. Imported oil is the principal balancing factor, and thus carries the combined impact of uncertainties in all other source projections. For this reason there is wide divergence in estimates of U.S. oil imports ten or twenty years from now. Table III-B shows a range from 4 to 15 Q/yr (2 to 7.5 MBD) in 1990 and from zero to 11 Q/yr (5.5 MBD) in 2000. There are estimates outside this range.

With few exceptions, current projections expect the completion of most nuclear plants now on the books, though opinions differ as to time of completion during the next two decades. Even if new orders are placed, this will barely, if at all, affect the number on stream for the balance of the century.

Expectations for coal- or shale-based gases and liquids are modest, with many observers judging the projection of the Synfuels Act of 4.2 Q/yr (2 MBD) in 1992 to be substantially unrealistic. Projections of solar energy (narrowly defined to exclude hydropower, biomass, etc.) are

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*National Energy Policy Plan, USDOE, July 1981, DOE/PE-0029.

TABLE III-A

U.S. ENERGY CONSUMPTION
(Quadrillion Btu Per Year)

	ACTUAL 1980	PROJECTED 1990		PROJECTED 2000		% CHANGE 1980-2000
		MIDRANGE	RANGE	MIDRANGE	RANGE	
Direct Oil[1/]	31.2	27	26-29	24	23-25	-23.0
Direct Gas[2/]	16.7	18	17.5-18.5	20	18-22	19.8
Direct Coal	3.5	5.5	5.0-6.4	7.5	6.6-8.2	114
Direct Renewable[3/]	1.8	2.7	2.6-2.8	4.2	3.9-4.5	133
Electricity	7.1	9.6	8.5-11	12	10-14	69
End-Use Consumption	60.3	63	59-67	68	62-74	
Conversion Losses*	17.7	24	21-27	32	28-36	
Total Consumption[4/]	78.0	87	80-94	100	90-110	

1/ Includes coal liquids.

2/ Includes synthetic gas from naptha and coal.

3/ Not included in conventional accounting.

4/ Range results from varying GNP assumptions.

*Includes conversion losses in generation and distribution of electricity and in production of synthetic fuels from coal and oil shale, but not similar conversion losses associated with other forms of energy, e.g. losses in petroleum refining and gas transmission.

Source: National Energy Policy Plan, USDOE, July 1981.

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TABLE III-8

U.S. ENERGY PRODUCTION AND IMPORTS[1/]
(Quadrillion Btu Per Year)

	ACTUAL 1980	PROJECTED 1990 MIDRANGE	PROJECTED 1990 RANGE	PROJECTED 2000 MIDRANGE	PROJECTED 2000 RANGE
DOMESTIC PRODUCTION					
Oil and NGL	20.5	18	16-21	20.0	17-24
Conventional	20.5	16.4	14.7-19.1	13.7	11.1-18.1
Unconventional[2/]	--	1.7	1.0-3.0	6.1	4.2-8.5
Natural Gas	19.8	18.5	16-21	18.0	14-21
Conventional	19.8	17.4	14.6-19.7	14.7	11.4-18.2
Unconventional[3/]	--	1.2	1.0-1.6	3.3	2.0-5.1
Coal[4/]	18.9	27	24-30	42	37-45
Nuclear	2.7	7.6	6.7-8.7	10.6	7.4-14.0
Hydro/Geothermal	3.2	3.6	3.3-3.9	4.3	3.7-4.9
Renewables[5/]	1.8	2.8	2.4-3.3	5.4	3.9-7.0
Total Production[6/]	66.9	78	68-88	100	83-116
NET IMPORTS					
Oil	13.3	10	4-15	3	0-11
Gas	1.0	2	1-3	2	1-3
Coal	(2.4)	(3.5)	(2.3-4.3)	(5.9)	(3.4-8.4)
Total Consumption[7/]	78	87	80-94	100	90-110

1/ Ranges in production reflect uncertainties about US energy supply.

2/ Includes shale oil and incremental enhanced oil recovery, but excludes coal liquids.

3/ Includes unconventional gas production from tight sands, Devonian shale and geopressurized methane. Does not include synthetic gas.

4/ Includes coal production for synthetics and coal exports.

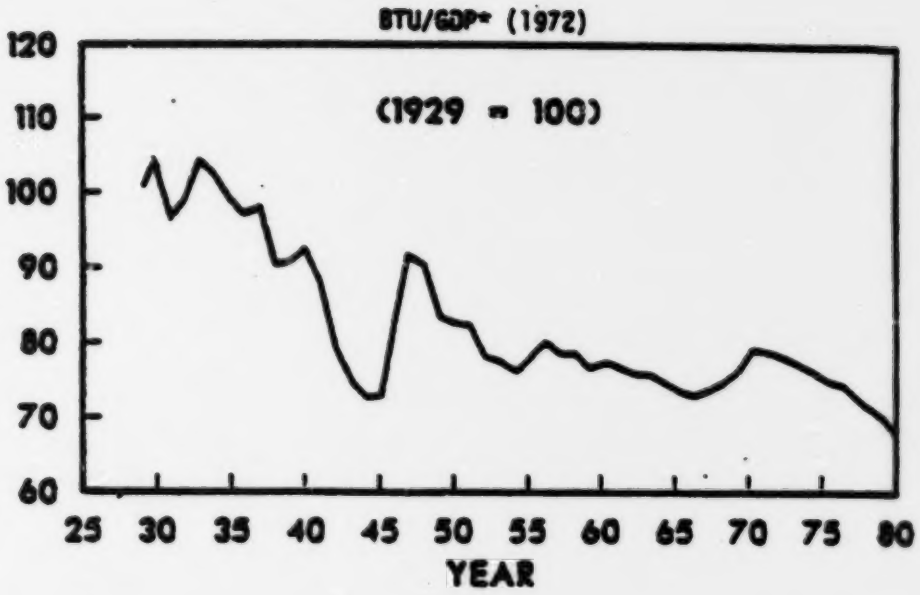
5/ Includes about 1.8 quads of biomass not currently included in EIA/DOE statistics.

6/ Totals may not add due to rounding.

7/ Includes 0.8 quads of net stock increases in 1980. Range in total energy consumption results from varying GNP assumptions.

Source: National Energy Policy Plan, USDOE, July 1981.

Figure III-2



*GDP represents gross domestic product

Source: Work in Process. Resources for the Future. Washington, DC: July 1981.

modest, largely connected with the continued depression in the consumer market, the cost of retrofitting and little progress in alleviation of institutional obstacles. Thus, for the next two decades oil, natural gas, and coal with a modest contribution of nuclear and an even more modest one of hydropower will remain the basic components of the U.S. energy supply.

Lest this quick sketch be interpreted as reflecting a mind-set of complacency, we should stress that a large number of assumptions may prove mistaken. These range all the way from the expected continuation of increased efficiency in use (i.e., how soon will that downward slope in the Btu/GNP ratio flatten out?) to the completion, more or less on schedule, of all nuclear plants now being constructed or having construction permits. Finally, a major perturbation in the oil import segment would play havoc with all projections.

B. Energy R&D Budget Analysis

Table III-C (FY1981) and III-D (President's proposals FY 1982) analyze the DOE budget by output energy form (electricity, fuels, and conservation) related to the resource base. Tables III-E and III-F analyze the budget by the same output energy forms related to the timing of impact: near term (next 10 years), mid term (1990-2010) and long term (beyond 2010). These tables are based on a categorization of programs selected by ERAB (see Appendix B-3).

C. Energy R & D Balance and Timing

Initial inspection of the FY 81 and FY 82 Federal energy R&D budgets (Tables III-C and III-D) reveals what <u>appear</u> to be imbalances in the program.

- There is very heavy stress on electrical technology in FY 81, further accented in FY 82, although it is noted that fluid fuels constitute our principal vulnerability.
- Similarly, within electricity, federally-sponsored nuclear programs are receiving a larger proportion of funding than the expected nuclear share of the U.S. energy mix during the next few decades.
- Finally, conservation, a very small fraction of the energy R&D budget in FY 81, is further and drastically reduced in FY 82, although it has so far contributed much more than supply augmentations in reducing our dependence on insecure oil imports.

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TABLE III-C

FY 81 Budget as a Function of Technology Area and Energy Form, Millions of $

Output Energy Form / Resource Base	Electricity	Fuels	Utilization and Conservation	Science and Technology Base	TOTALS
Conservation	-	-	311.5	-	311.5 (7%)[9%]
Nuclear & Fusion	1793.1 *	-	-	-	1793.1 (39%)[50%]
Coal	66.6	482.4	37.4	-	586.5 (13%)[16%]
Solar	224.3	49.6	363.1	-	637.0 (14%)[18%]
Geothermal	153.6	-	-	-	153.6 (3%)[4%]
Oil/Gas/Shale	-	78.9	-	-	78.9 (2%)[3%]
Science and Technology Base	-	-	-	979.3	979.3 (22%)
TOTALS (% of Total) [% less science and tech base]	2237.6 (49%) [63%]	621.0 (14%) [17%]	712.0 (16%) [20%]	979.3 (21%)	4549.9 [3570.6]

*Centrifuge R&D costs included, construction costs excluded.

[ ] signify Science & Technology Base funding excluded.

TABLE III-D

President's FY 82 Budget as a Function of Technology Area and Energy Form, Millions of $

Output Energy Form / Resource Base	Electricity	Fuels	Utilization and Conservation	Science and Technology Base	TOTALS
Conservation	-	-	126.7	-	126.7 (3%)[9%]
Nuclear & Fusion	2022.2 *	-	-	-	2022.2 (53%)[72%]
Coal	-	282.4	38.8	-	321.2 (8%)[11%]
Solar	66.9	30.5	128.7	-	226.1 (6%)[8%]
Geothermal	46.8	-	-	-	46.8 (1%)[2%]
Oil/Gas/Shale	-	46.5	-	-	46.5 (1%)[2%]
Science and Technology Base	-	-	-	1073.4	1073.4 (28%)
TOTALS (% of Total) [% less science & tech base]	2135.9 (55%) [76%]	359.4 (9%) [13%]	294.2 (8%) [11%]	1073.4 (28%)	3862.9 [2789.5]

*Centrifuge R&D costs included, construction costs excluded.

[ ] signify Science & Technology Base funding excluded.

The questions whether these apparent imbalances are truly misallocations, or are justified, are addressed in detail in later sections of the report, and ERAB's recommendations for specific allocations within the overall budget are summarized in the conclusions at the end of the report.

No "correct" balance among energy forms and resources can be defined a priori: it would be absurd, for example, to assign coal or natural gas a "fair" share of Federal research dollars if there are no promising research projects in these areas which industry cannot be expected to undertake.

Tables III-E and III-F illustrate the Reagan administration shift toward research with longer range impacts. ERAB does not question this shift as a general proposition as long as it recognizes valid exceptions. Indeed, private industry is not likely to undertake long-range high risk R&D. It is also the area in which energy R&D can expect the highest payoffs and addresses the great national energy objectives -- affordable and environmentally benign sources of electricity and fluid fuels, used efficiently, for the indefinite future.

A summary of the timing impact of the various supply technologies used in preparing Tables III-E and III-F appears in Appendix B.

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TABLE III-E*

FY81 Budget as a Function of Energy Form and Timing of Impact, Millions of $

	Near	Mid	Long	TOTALS
Electricity	827.2 **	539.6	870.8	2237.6 (49%)[63%]
Fuels	96.3	482.5	42.0	620.8 (14%) [17%]
Utilization and Conservation	589.2	203.0	-	712.2 (16%)[20%]
Science and Technology Base	-	-	979.3	979.3 (21%)
TOTALS (% of Total) [% less science & tech base]	1432.7 (31%) [40%]	1225.1 (27%) [34%]	[912.8][26%] 1882.1 (42%)	4569.9 [3570.6]

*The timeframe for impact of the various technologies used in making the above table is given in Appendix B.

**Centrifuge R&D costs included, construction costs excluded.

[] signify Science & Technology Base funding excluded.

TABLE III-F*

President's FY82 Budget as a Function of Energy Form and Timing of Impact, Millions of $

	Near	Mid	Long	TOTALS
Electricity	802.1 **	406.1	928.0	2138.2 (58%)[77%]
Fuels	60.7	274.0	24.4	359.1 (9%)[13%]
Utilization and Conservation	174.2	120.0	-	294.2 (8%)[10%]
Science and Technology Base	-	-	1073.4	1073.4 (28%)
TOTALS (% of Total) [% less science & tech base]	1037.0 (27%) [37%]	800.1 (21%) [29%]	[982.4][34%] 2025.8 (52%)	3862.9 [2789.5]

*The timeframe for impact of the various technologies used in making the above table is given in Appendix B.

**Centrifuge R&D costs included, construction costs excluded.

[] signify Science & Technology Base funding excluded.

IV. ELECTRIC-RELATED SUPPLY PROGRAMS

A. Introduction

Electric-related supply programs constitute $2.18 of the FY 82 President's budget in energy supply R&D. Of this, $2.08 is devoted to nuclear fission and fusion R&D. The programs classified under this heading are on average larger in size than those in other R&D categories. This is because programs involving nuclear fission and nuclear fusion necessarily involve large research teams and also frequently involve expensive equipment and facilities for demonstration projects. This applies whether the impact of the program is near term as in research on conventional reactor systems, or long term as in fusion research.

The extent to which these programs should be financed by the Federal Government rather than by private industry is regarded by ERAB members as a key criterion. In many programs the Federal Government has assumed responsibilities (uranium enrichment, nuclear waste disposal and nuclear safety) that are not now assumed by private industry. In other programs (e.g., magnetohydrodynamics, breeder reactors, magnetic fusion) the risk is presently too great and the time scale too long for substantial private industry funding. For such programs the key criteria for continued government funding are the chance of technical success and the ultimate potential for providing a secure energy supply.

A major shift in the Administration's Energy Policy has been to give increased support to assuring the viability of the light water reactor (LWR) electric power industry. In order to carry out this new policy, ERAB recommends that the Administration give high priority to:

- R&D in nuclear waste disposal, particularly in accelerating early demonstration of specific, most promising waste disposal methods
- R&D on current generation LWR's

The summary of ERAB conclusions on priorities and funding for electric related supply is given in Table IV-A.

B. Near Term Nuclear Programs

Conventional reactor systems ($81.5/$68.0)* Increased funding for R&D on conventional reactor systems is recommended. Increased funding

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*FY81 funding/FY82 President's Request in million $ are shown in parenthesis.

should be concentrated in high pay-off areas -- Three-Mile Island analysis, nigh burn-up fuel, safety related research and lower enriched fuel for research reactors while high temperature gas reactor funding has a lower priority.

Nuclear waste programs ($499.8/$617.6) ERAB thinks that the proposed funding for these programs is satisfactory, even though they have the highest priority. Funding increases are not considered necessary because technology is regarded as available; the main obstacles are political. It is recommended that demonstration and site work should be accelerated. Safe waste disposal is critical for assuring the viability of the light water reactor cycle.

Uranium enrichment programs ($142.3/$149.7) There is strong agreement that funding for advanced isotope separation and advanced centrifuge R&D should be continued. It should be noted that $293.3M in FY81 funds and $695.8M in FY82 funds for construction of the near term gas centifuge capacity were excluded from consideration of R&D expenditures as the decision on this project should be based on normal payback criteria. In this regard, the ERAB recommends that consideration be given to formation of a quasi-government or private corporation to handle enrichment on a commercial basis.

Uranium resources assessment ($25.9/$5.8) The President's 1982 Budget for this program represents a substantial reduction from past plans. ERAB recommends that funding be continued at approximately the 1982 budget level so that gathering of readily accessible data and periodic publication of reports can be continued.

C. Long Term Nuclear Programs

Liquid metal fast breeder reactor (base program) and fuel cycle R&D ($419.4/413.9) It is considered desirable to maintain present levels of effort in the LMFBR base program and fuel cycle R&D, except those aspects that are closely tied to near term demonstration should be reviewed for appropriate changes. Breeders with attendant reprocessing could have a high ultimate impact on energy supply security. Although the ultimate impact is post-2000, ERAB recommends that this base technology program must be maintained.

Clinch River Breeder Reactor ($172.0/$254.0) The ERAB believes that the construction of a breeder reactor demonstration at this time is not an urgent priority and thus, under current budget constraints, recommends that such a demonstration be delayed until a future time.*

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*See dissenting opinion and additional remarks in Appendix D.

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TABLE IV-A

SUMMARY
R&D PRIORITIES
ELECTRIC SUPPLY PROGRAMS

RANK[1]	PROGRAM	PRIORITY[2]	President's FY82 Budget	ERAB Funding[2] Recommendations
1	Nuclear Waste Commercial (NE)	HIGHER	227.6	Same
2	Nuclear Waste Defense (DP)		390.0	Same
3	Conventional Reactor System (NE)	MEDIUM	68.0	More
4	Breeder Reactor Fuel Cycle R&D (NE)		26.1	Little Less
5	U E - Centrifuge (NE)[3]		64.5	Same
6	Liquid Metal Fast Breeder (NE) (Base Program)		387.8	Same
7	Solar Power Technology (CE)		19.4	Less
8	U E - Advanced Isotope Separation (NE)		85.2	Same
9	Magnetic Fusion (ER)	LOWER	456.1	Little Less
10	Light Water Breeder Reactor (NE)		58.0	Less
11	Uranium Resources Assessment (NE)		5.8	Same
12	Electric Energy & Storage Systems (CE)		47.5	Less
13	Hydropower (CE)		0.0	Zero
14	Clinch River Breeder Reactor (NE)		254.0	Less
15	Geothermal (CE)		46.8	Less
16	Magnetohydrodynamics (FE)		0.0	Zero

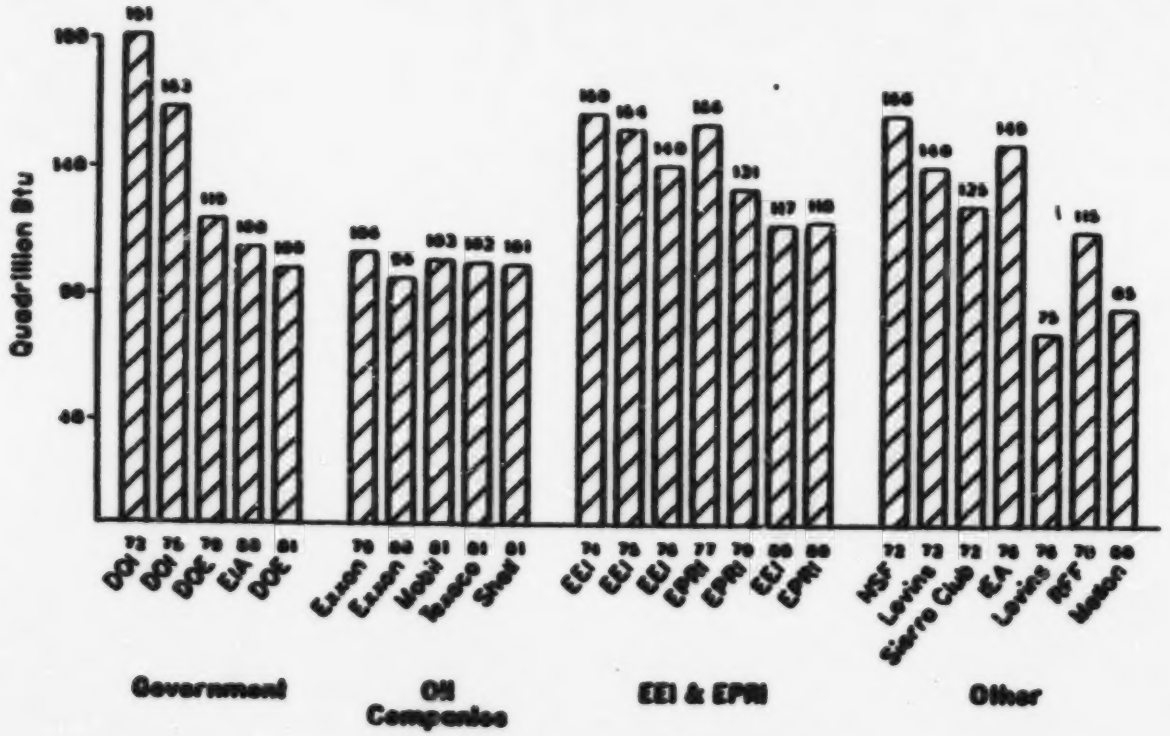
[1]Rankings represent consensus view of ERAB and should be interpreted with caution; the differentiation between any two consecutive programs is not necessarily significant.

[2]Priority reflects ERAB view of overall merit of program; funding recommendations relative to the President's budget request for FY82 reflect on Federal role.

[3]Excludes $695.8 million for centrifuge plant construction.

FIGURE III-1

TRENDS IN U.S. ENERGY DEMAND PROJECTIONS FOR THE YEAR 2000



Source: Office of Policy, Planning and Analysis, Department of Energy, 1981

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Light water breeder reactor ($60.2/$58.0) This program has the potential of extending the long-term supply of nuclear fuels. The ERAB agrees however that decreased funding for the LWBR may be warranted. The unattractive economics and the lack of industry interest are cited as reasons. Further reductions in funding are recommended.

Magnetic fusion ($391.0/$456.1) ERAB members agree on the long-term importance of this program and that the primary Federal role should be to continue to sponsor a joint program of the federal laboratories, industry and university scientific communities to determine if fusion can be practical.* The potential payoff is very large, but is much too far in the future for significant private sector support. There was agreement that a stretch-out of the program is possible if budgetary pressures demanded it, but maintenance of a substantial level of Federal R&D funding is judged to be essential. It is also recommended that an enhanced effort to examine the use of fusion for the breeding of nuclear fuels deserves consideration.

D. Non-nuclear Electric Programs**

Solar power technology ($112.1/$19.4) This technology area includes wind energy and Ocean Thermal Energy Conversion. (Photovoltaics is included under Solar Applications for Building in the conservation section.) Wind energy is regarded as the most technologically advanced and as having achieved commercial potential. Since there are no critical technical R&D problems preventing commercialization by industry, and since there is limited potential to be realized, the Board recommends less funding for this technology. In the case of OTEC, technical feasibility has been shown on a small scale, thus fulfilling the primary Federal role. The Board recommends that remaining funding should be used to facilitate the transition to industrial commercialization.

Hydropower ($2.4/$0.0) Technical success for small scale hydropower has been proved, and private industry is active (although it is noted that U.S. manufacturers of low-head hydro equipment are absent). Little, if any, R&D is needed; therefore, the Board recommends phase-out of funding. Investment tax and other credits are sufficient to commercialize this technology.

Magnetohydrodynamics ($66.5/$0.0) There are other technologies (such as combined cycle gas turbines) available for increasing the

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*See Report on the DOE Magnetic Fusion Program, prepared by the Fusion Review Panel of ERAB, August 1980.

**Dispersed electric and co-generation technology, direct coal combustion, and fuel cell programs included in Section VI.

efficiency of large, central power generation stations that do not have the extreme temperature/erosion problems associated with the use of coal in MHD. For this reason the Board foresees little commercial demand for this technology and therefore concurs with the planned phase-out of this program. The Board recommends that existing government facilities be utilized by industry if they wish to pursue research in this area.

Geothermal ($153.6/$46.8) Strong agreement that funding should be decreased is predicated upon the fact that private industry should be undertaking the development of the part of the resource that appears economic, and is in fact doing so. The program is also seen as having low impact on national energy supply. If a Federal geothermal program is continued, emphasis should be on low temperature process heat and completing the ongoing hot dry rock program, not on geopressured energy resources, where the technical risk appears high or geothermal electric where industry is capable of solving the remaining problems.

Electric Energy and Storage ($109.8/$47.5) This program consists of two parts, R&D on electricity transmission and distribution and R&D on energy storage. R&D on electricity transmission and distribution is regarded as essentially the responsibility of private industry. As a result, there is agreement that the overall program should decrease in such a way that at least some results can be obtained from programs now at the point of yielding valuable data. R&D on energy storage, however, is regarded as important; this part of the program should be strengthened. The Board supports direct participation of Federal electricity producing and marketing agencies in the Electric Power Research Institute as a mechanism for supporting R&D on utility-related needs.

V. FUELS SUPPLY TECHNOLOGY

A. Introduction

Fuel supply technologies represent approximately 9% of the President's total FY 82 budget for energy supply. This sector of energy supply is not as highly regulated as the electric energy industry and has historically developed these supplies with private resources. In general, ERAB concludes that the more urgent technologies, such as enhanced gas and oil recovery, can have an early impact in the market but that the Federal role is significantly less since private industry will develop these sources. Conversely, as discussed in Chapter VII, on the Science and Technology Base, the Federal Government has important roles to play in environmental research on accumulation of CO_2 in the atmosphere and on acid rain. Either of these problems has the potential for substantially limiting expanded use of fossil fuels.

Table V-A provides a summary of the relative priorities and recommended funding levels discussed is this section.

B. Synthetic and Natural Gas

Enhanced Gas Recovery ($30.6/$10.2)* Enhanced gas recovery is given a medium priority with respect to urgency, benefit/cost ratio, supply security and a high priority with respect to technical and economic potential and health and environment. Government funding of the program should be decreased because the private sector is conducting adequate research and development in these areas. Only low level government funding is needed to assist in the funding of some private sector experiments by small companies and to maintain government awareness of what is being accomplished.

Surface Coal Gasification ($69.6/$53.4) Gasification is the most important step in the conversion of coals to synthetic gases and liquids by almost every process and possibly even in the conversion to electricity. While private sector efforts here and abroad are very extensive a continued DOE effort is well justified. Specifically, DOE gasification R&D should concentrate on (a) exploration of new process concepts; (b) R&D on the various auxiliary steps such as evaluation and preparation of gasifier feeds from U.S. coals and raw gas clean-up systems.

Most importantly R&D towards closing the gaps in the knowledge of environmental issues related to gasification is not only important but a most appropriate area for government research.

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*FY81 funding/FY82 President's request in million $ are shown in parenthesis.

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TABLE V-A

SUMMARY
R&D PRIORITIES
LIQUIDS AND GAS SUPPLY PROGRAMS

RANK[1]	PROGRAM	PRIORITY[2]	President's FY82 Budget	ERAB Funding[2] Recommendations
1	Enhanced Oil Recovery (FE)	HIGHER	20.1	Less
2	Advanced Research and Environmental Control Technology (FE)	MEDIUM	94.5	Same
3	Enhanced Gas Recovery (FE)		10.2	Less
4	Coal Liquefaction (FE)		105.2	Less
5	Biomass Energy (CE)		20.5	Same
6	Surface Coal Gasification (FE)		53.4	Less
7	Mining R&D (FE)	LOWER	21.0	Less
8	In Situ Oil Shale (FE)		16.3	Less
9	Alcohol Fuels (CE)		10.0	Same
10	In Situ Coal Gasification (FE)		8.3	Less

[1]Rankings represent consensus view of ERAB and should be interpreted with caution; the differentiation between any two consecutive programs is not necessarily significant.

[2]Priority reflects ERAB view of overall merit of program; funding recommendations relative to the President's budget request for FY82 reflect on Federal role.

Since a very broad pilot and demonstration program is under way outside DOE (much of it abroad) the need for continued pilot plant operation is eliminated (example Bi-gas project). R&D elsewhere involves efforts on both air- and oxygen-blown gasifiers, thus a separate DOE program on air-blown (low-BTU) gasifiers appears redundant.

In view of the above, the Board concludes that a funding level somewhat below that proposed in the President's budget would be adequate.

In-Situ Coal Gasification ($10.0/$8.3) In-situ gasification has been attempted here and abroad for many decades but with limited success. One of the more interesting parts of this DOE program aims at gasification of coal in steeply dipping beds. Tests now underway should be completed during the next year. This is a unique application which can be evaluated at the end of the present program; if successful, further development can then be carried on by private sector sponsors with an interest in this type of coal deposit. With this exception, the in-situ coal gasification program has a low probability of a commercially viable success and can be phased out.

C. Petroleum and Synthetic Liquids

Enhanced Oil Recovery ($16.2/$20.1) ERAB gives enhanced oil recovery a very high priority with respect to technological and economic potential, benefit/cost ratio, urgency, supply security and health/environmental problems. However, the Board recommends that Federal funding, even though relatively small, be decreased. A small Federal expenditure can be justified only for some of the environmental research and to keep current with technical developments in the private sector. This recommendation stems from the considerable evidence that the larger energy companies have the ability, the know-how and the willingness to engage in sustained long-term R&D. Also, the oil companies have the financial strength to commercialize enhanced oil recovery processes without government financed demonstrations.

Coal Liquefaction ($277.0/$105.2) Commercially demonstrated coal liquefaction technology is currently available. This is based on the so-called "indirect" route. Large plants are now in operation abroad; a full size plant is under construction in the U.S. that will demonstrate the critical components. Although this plant is designed to produce synthetic natural gas, not liquids, some 4/5 of the total process sequence is identical with that required for liquids, specifically the gasification and gas purification. Improved processes for conversion of the resulting CO/H_2 mixtures to liquids are in the process of commercialization. Although the competitive route to coal based liquids, namely direct hydrogenation, was once considered superior, it has not been

practiced for 35 years and now requires an extensive R&D and demonstration program if it is to become competitive. This is desirable to avoid reliance on a single technology. DOE has been engaged in coal hydrogenation for over ten years and has advanced the art to the point where the private sector can evaluate the merit of direct hydrogenation. At the present time, there is no unanimity on any inherent advantage of direct hydrogenation over indirect liquefaction although it should be more thermally efficient in principle.

Outside of DOE activities, the Synthetic Fuels Corporation is even now considering support of several commercial scale liquefaction projects. All of the foregoing has made it possible for DOE to begin phasing out the large scale pilot and demonstration hydrogenation projects that were intended to close the gap between indirect and direct liquefaction of coal. This should be done in a manner protecting the major investments in these projects which include the 200 ton/Day Exxon Donor Solvent Unit, the 250 ton/Day H-Coal Catalytic hydro unit and the 6000 ton/Day Solvent Refined Coal-I (SRC-I) demonstration project; in context with the latter it should be noted that real progress in coal hydrogenation (by any one of its many variants) will ultimately require a large commercial scale demonstration facility to resolve the difficult engineering problems. As a result, completion of the present design phase of SRC-I will serve to highlight the key difficulties on which future R&D should concentrate. It now appears that DOE will remain the key source of future R&D in direct liquefaction (hydrogenation). ERAB supports the continued effort in this area by DOE at the laboratory and small pilot plant scale with particular emphasis toward a broadening of the program to explore a wider range of technologies including 2-stage conversion based on carbonization or extraction with catalytic hydrocracking, new catalyst development, new solid/liquid separation.

DOE's intention to pursue development of improved indirect-liquefaction processes is not considered appropriate by ERAB, given the very extensive effort in the private sector; therefore, ERAB recommends elimination of this part of the liquefaction program.

In summary, ERAB recommends a reduced budget for coal liquefaction focusing on R&D in direct liquefaction area and particularly on R&D to resolve the environmental problems associated with this technology.

<u>In-Situ Oil Shale</u> ($32.2/$16.3) In-Situ Oil Shale is given a medium priority with respect to urgency, technical and economic potential, and benefit/cost ratio. Oil shale is given a high priority with respect to supply security. Since the rich shales will be used first and are concentrated in about a 600 square mile area in Colorado, special attention should be given to the environmental problems that will arise if commercial production rises to the level of one or two million barrels per

day. Likewise, the infrastructure needed to support this level of production in such a small area needs study. The government has an important role to play with respect to both the environment and the infrastructure problems; the present funding should be focused on these problems.

The in-situ oil shale program is really only a minor variation of the process for exploiting the oil shale resource. Both subsurface retorting and surface retorting of shale is under active investigation by the private sector. Several companies are designing commercial facilities with the intention of producing oil from shale in the late 80's. There is no need for a government role in the development of the technology of recovery of oil from oil shale; Federal expenditures in this area should be eliminated.

D. Biomass and Solid Fuels

Biomass Energy* ($31.7/$20.5) and Alcohol Fuels ($18.0/$10.0) Both programs are given a high priority with respect to technical potential. Biomass is given a medium priority with respect to all other criteria. Alcohol fuels differ from biomass in that they have a lower priority with respect to economic potential, benefit cost/ratio, supply security and urgency. The Board recommends that these funding levels not be changed. Particular attention should be given to the conversion of lignocellulose to fuels.

Mining R&D ($40.2/$21.0) Coal mining is an area deserving of substantial attention and support of R&D by the Federal Government. Much of this work is conducted by agencies other than DOE.

The Board recommends that coal mining R&D be concentrated in one agency and that DOE/FE instead concentrate its efforts on innovative concepts, particularly for preparation of fine sized coal.

E. Advanced Fossil Energy Research

Advanced Research and Environmental Control Research ($95.8/$94.5)** The Board believes this program should be funded at its present level but with some redirection.

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*Report of the Biomass Panel of the Energy Research Advisory Board, November 1981.

**For FY82 budget request $67.1 for advanced fossil R&D and $27.4 for environmental control technology development.

Advanced Research and Environmental Control Technology R&D (FE) includes, in addition to all exploratory R&D on coal conversion, research towards substitution of coal for oil and gas in direct combustion; this is an extremely important program since the vast majority of coal must be used as boiler fuel over the next several decades, both in existing and new units. Equally important is the development of improved emission control technology to reduce SO_x, NO_x and particulates in fluegas. The Board therefore urges that these parts of the Advanced Research and Environmental Control Programs be increased and given higher priority at the expense of other activities in this program. The remainder of the program is designed to provide technology base support to other fossil energy programs in such areas as materials, diagnostics, instrumentation, and applies research on new concepts and processes. This work is also important, but is longer range and should be closely coordinated with other technology base efforts.

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VI. UTILIZATION AND CONSERVATION TECHNOLOGY

A. Introduction

Utilization and conservation technologies represent approximately 8% of the total FY 82 budget for energy research and development (see Tables III-C) divided 4% for utilization and 4% for conservation. The President's budget itself reflects severe budget cuts for these areas, up to 80% reductions over FY 81 in some cases.

Relative to their potential contributions to the solution of the near- and medium-term energy problems, there is an imbalance in the allocation of R&D funds between the conservation programs and those directed at supply. The budget needs a reordering of priorities to reflect better the opportunities that exist for efficiency improvements and the unique Federal role in conservation R&D.

ERAB's views on this point are reflected in the high priorities that members gave to conservation R&D. In the Board's ranking, three of the top five programs (and five of the top ten programs) of the entire Department's R&D projects were drawn from conservation/end-use R&D.

The priorities assigned to conservation and end use programs are summarized in Table VI-A.

B. Conservation Programs

Buildings and Community Systems ($53.0/$28.0)* ERAB ranked research on Buildings and Community Systems in the high priority range. Recognizing its importance to the energy problem as a whole and to the oil import problem particularly, the Board noted that private sector R&D in this area is rare because of the fragmented and undercapitalized nature of the industries involved. The efficiency improvements that can be made in existing structures are large, and no R&D capability exists within the remodeling or retrofit private sector. A Federal role is highly appropriate in this field; indeed, Federally-supported work at several of the National Laboratories, university centers, and elsewhere has been productive in product and design innovation and in transferring research results into the field quickly. The same is true of the consumer products work undertaken by these groups.

ERAB recommends that funding levels in this area be increased, emphasizing R&D that the private sector is not funding, while maintaining active R&D and technology transfer programs involving industry.

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*FY81 funding/FY82 President's request in million $ in parenthesis.

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TABLE VI-A

SUMMARY
R&D PRIORITIES
CONSERVATION AND UTILIZATION

RANK[1]	PROGRAM	PRIORITY[2]	President's FY82 Budget	ERAB Funding[2] Recommendations
1	Coal Combustion Systems	HIGHER	38.8	Same
2	Buildings and Community Systems		28.0	More
3	Industrial Conservation		0.0	More
4	Transportation Conservation	MEDIUM	37.0	Same
5	Solar Applications for Buildings		84.7	Same
6	Heat Engines and Heat Recovery		15.5	Same
7	Multi-Sectors Conservation		17.5	Same
8	Fuel Cells		28.6	Same
9	Solar Applications for Industry	LOWER	44.0	Less

[1]Rankings represent consensus view of ERAB and should be interpreted with caution; the differentiation between any two consecutive programs is not necessarily significant.

[2]Priority reflects ERAB view of overall merit of program; funding recommendations relative to the President's budget request for FY82 reflect on Federal role.

The Federal Energy Management Program will be one of the subjects of discussion by the Board's Conservation Panel. It is not an R&D program; its shortcomings appear to have little to do with budget levels.

Transportation Conservation ($102.1/$37.0) Transportation Conservation R&D ranks at the top of the medium priority group of R&D programs. ERAB recommends that the funding level remain the same.

R&D emphasis should shift from the automobile to the heavy freight truck sector. The vehicle propulsion technology development program should be transferred to industry in an orderly way; the market, driven by consumer preference and foreign competition, should determine the necessity for and the direction of this R&D, not the Federal government. Likewise, electric and hybrid vehicle R&D should be sharply reduced.* Alternative fuels utilization R&D should continue but with closer cooperation with potential ultimate users. The transportation systems utilization activities deserve firm support. This program includes work that the private sector either will not do on systems improvements or cannot provide candidly.

Multi-Sector Conservation ($25.8/$17.5) The Multi-Sector Conservation program historically has been made up of three elements: the small inventions program, the appropriate technology program, and the Energy Conversion and Utilization Technology (ECUT) program. The President's budget has eliminated the appropriate technology program, but kept portions of the other two activities.

Even though it is required by legislation, the inventions program deserves relatively less emphasis within the Department; money devoted to it could be more productively used in the ECUT program, particularly if that program is restructured along the lines the Board recommends.

ECUT now devotes a major share of its budget to research on understanding combustion phenomenon, heat exchanger technology, chemical processes, and materials. Much of this work has been cooperative with the using industries and appears to be bearing fruit.

ECUT management itself, working with a group of outside reviewers drawn from industry and elsewhere, has recommended that its research be principally directed toward work on chemical and physical processes that have generic applications in improving efficiency. ERAB concurs with augmenting ECUT's activities along these lines, using funds drawn from savings realized from the phasing out of the inventions and the appropriate technology program.

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*See dissenting opinion in Appendix D.

Overall, ERAB recommends that the funding level remain the same, but that virtually all the R&D money be used in a redirected ECUT program.

Industrial Conservation ($67.3/$0.0) Industrial Conservation ranked in the High category when compared with all other DOE R&D programs. ERAB recommends that this program be restored close to FY81 funding levels. Thus, ERAB recommends an increase in the proposed budget.

ERAB expressed concern that, although all industries have incentives to conserve energy, many of them lack the ability to conduct R&D either because of their fragmented industrial structure or because of historic failure to support research. This appears to be true of many small and medium sized businesses that, in the aggregate, consume large amounts of energy. Short-term, high-payoff R&D will not be conducted unless Federal leadership is given.

ERAB noted that many of the industrial conservation projects previously undertaken by DOE have been highly effective and have included cost recovery features for the Government. Continuity and continued skilled management are important features in the prior (and future) success of this R&D component.

C. Solar Programs

Solar Applications for Buildings ($224.9/$84.7) The Solar Applications for Buildings program was given a high priority within the medium range. ERAB believes the funding should remain the same, recognizing that the lower funding levels will stretch out the time frame for achieving lower cost photovoltaic electricity.

Photovoltaic (PV) R&D has approximately 75% of the budget in this program. PV and fusion are the major renewable options available for electricity generation if the CO_2 problem is found to be significant. Major cost reductions in PV have been achieved, and further reductions leading to an attractive economic potential appear highly likely if Federal funding is maintained. A separate report recently submitted to ERAB by the Solar Photovoltaic Advisory Committee of the Board provides detailed recommendations in this area. A halving of the budget for PV (as the President has recommended) will mean that development of low-cost PV will slow down, increasing the opportunities for foreign manufacturers to dominate the technology. Therefore, continued support of PV is important to maintain the momentum developed by this program. Emphasis should be placed on advancing those photovoltaic technologies required to achieve cost reductions in both module and cell areas as well as balance of system areas. Premature demonstration activities should be curtailed.

Continued Federal support for basic and applied research in passive solar technology will pay high dividends. The building industry is fragmented and has no institutions capable of supporting this R&D activity. R&D activity on active, building-by-building solar heating should be relinquished to private industry. Research on passive solar cooling deserves support, particularly cooling systems that are effective in humid sections of the country. Similarly, solar pond technology should be continued since it is highly promising.

Solar Thermal Applications for Industry ($138.3/$44.0) ERAB recommends reduced overall funding with increased emphasis on selected elements within this medium priority program. High temperature collectors (concentrators and receivers) deserve increased support because of their great versatility in application and the lack of industrial R&D. Dish technology development should remain at the module level until technical and economic feasibility has been attained with several different modules.

Areas to be considered for reduced Federal support include those technologies where significant industrial interest is expressed already, specifically development in heliostat and external steam receivers, operation of Solar One and Shenandoah, and technology for process heat applications.

D. Other End-Use Technologies

Direct Coal Combustion Systems ($37.4/$38.8) No other direct combustion alternative exists that eliminates the need for scrubbers and is close to commercialization. Hence, ERAB recommends that the direct coal combustion systems program be continued with the same level of funding, although some redirection of emphasis is appropriate.

Atmospheric fluidized bed combusters for industrial applications are ready to move into the commercial market in configurations supported by the Federal Government in the past; further funding is no longer needed and should support instead advanced combustors that appear capable of burning with lower SO_x and NO_x emissions.

Research on pressurized fluidized bed combustors for utility and industrial applications is longer term with a promise of providing multifuel capabilities in, for example, cogeneration applications. In addition, advanced combustion concepts and alternative fuel utilization research may provide environmental or fuel substitution advantages.

Fuel Cells ($32.0/$28.6) Fuel cells represent an undeveloped technology with important environmental advantages. Although both the electric and gas industries are supporting research, some Federal support is

essential for its continuation. ERAB recommends no change in the level of funding.

During FY 82, the phosphoric acid fuel cell technology will be tested in a 4.8 MW plant under construction in New York City; extension of the program should be assured to include testing of coal-derived fuel (methanol) and possibly shale liquids. The solid oxide fuel cell, while beyond the proof-of-principle stage, still requires subsystem development. In addition, the molten carbonate fuel cell with its high susceptibility to sulphur catalyst contamination and other high risk advanced technologies deserve continued support.

Heat Engines and Heat Recovery ($31.5/$15.6) ERAB recommends no change in funding for the heat engine program, but some redirection of effort is needed. The coal fueled diesel engine has little chance of economic success; its funding should be shifted to development of high temperature gas turbines. Since high risk technology for high efficiency central and dispersed power systems is the goal of this program, a major effort directed at higher efficiency/higher temperature gas turbines, the sine qua non for an efficient combined cycle, coal-fired power system, is more appropriate.

The heat recovery program supported with carry-over funds from FY 81 should be continued with additional funding requested for continuation of uranium enrichment plant heat recovery projects in FY 83.

VII. SCIENCE AND TECHNOLOGY BASE

A. Introduction

It has long been agreed that the Federal Government must play a primary role in the maintenance of research programs that contribute to new understanding and to expansion of the U.S. technology base. Generally, the activities sponsored by the DOE for this purpose represent an appropriate set of programs for maintaining and expanding the energy technology base, the body of knowledge and know-how upon which the nation must rely for implementation of our overall objectives in the energy field.

The program elements in DOE that constitute the science and technology base fall largely into two categories: general science and energy supporting research. It is the assessment of the Energy Research Advisory Board that both components are appropriate, represent research of high quality and scientific potential and, with minor exceptions, especially in basic and biological energy sciences, that the President's proposed budget for FY 82 calls for an adequate allocation of funds for these programs or allows for adjustments and reallocations that can assure continued progress towards the Nation's goals under the overall constrained budgetary circumstances.

Table VII-A summarizes the relative priorities and funding recommendations. It should again be noted that a separate set of criteria were used to evaluate these programs; thus, the rankings are not directly comparable with the R&D programs discussed in prior sections of this report.

B. General Science

These programs in General Science support the Nation's effort in high energy physics, nuclear physics, general life sciences, nuclear medicine, and the preparation of certain radioactive and heavy isotopes for scientific and commercial uses in a myriad of endeavors. Historically and by interagency agreement, DOE is the lead agency for these national programs that are of long-range importance in the energy effort but, in addition, have broader significance for continued progress in many commercial developments, in space, in defense, and in health-related fields. These basic research programs are sometimes characterized as a "national trust." ERAB proposes no change in these missions and no modification in present budgetary projections for them.

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TABLE VII-A

SUMMARY
R&D PRIORITIES
SCIENCE AND TECHNOLOGY BASE

RANK[1]	PROGRAM	PRIORITY[2]	President's FY82 Bucget	ERAB Funding[2] Recommendations
1	Materials Sciences	HIGHER	112.1	More
2	Climate and CO_2 Research		16.7[3]	More
3	Chemical Sciences		73.9	More
4	Biological & Environmental Research		153.8[3]	More
5	Biological Energy Sciences		9.4	More
6	Nuclear Medicine		50.5	Same
7	High Energy Physics		392.7	Same
8	University Research		10.6	More
9	Environment and Safety		49.6	Same
10	Engineering, Math & Geosciences		32.3	Same
11	Nuclear Physics		122.9	Same
12	Nuclear Sciences	MEDIUM	37.7	Same
13	Advanced Energy Projects		8.2	Same
14	Technology Assessments	LOWER	3.0	Same

[1]Rankings represent consensus view of ERAB and should be interpreted with caution; the differentiation between any two consecutive programs is not necessarily significant.

[2]Priority reflects ERAB view of overall merit of program; funding recommendations relative to the President's budget request for FY82 reflect on Federal role.

[3]The Biological and Environmental Research Program includes Climate and CO_2 Research with a total budget of $170.5 M.

High Energy Physics ($348.2/$392.7)* This program is the Nation's principal effort to explore the fundamental components and interactions of matter. It depends upon unique, large scale, high cost experimental facilities that are used by laboratory and university scientists to probe ever deeper into the structure of matter and the universe. Support of such research is a Federal responsibility since it is not expected to have commercial significance, although many commercial applications have arisen from technology developed through this program. Some university scientists who work at DOE facilities are supported by NSF; a joint planning process is used to ensure coordination. Support at about the present level will continue a longstanding U.S. commitment toward excellence in this field of science.

Nuclear Physics ($109.2/$122.9) The Nuclear Physics Program addresses the fundamental interactions and structure of the atomic nucleus. It develops and uses unique large-scale facilities at national laboratories and universities with a particular emphasis on heavy ion research and meson interactions with matter. Such research is long-range and would not be carried out without Federal support. Joint planning with NSF, the only other sponsor in this field, is intended to provide a balanced national effort. Support should be continued at about the same level-of-effort.

General Life Sciences and Nuclear Medicine ($45.9/$50.5) This combination of long-term biological research and unique medical application of nuclear techniques is clearly of value to the public and is unlikely to be undertaken by private industry. The genetic and cellular research provides a fundamental scientific underpinning for the more applied Biological and Environmental Research program while the nuclear medicine component exploits unique DOE facilities for the production, testing and application of radioisotopes. The current level-of-effort seems appropriate.

C. Energy Supporting Research

The Energy Supporting Research Programs of DOE are intended to expand the nation's technological alternatives by explorations in chemistry, materials science, biology, engineering and matnematics, geosciences and environmentally-related fields of health. Particularly important is the Climate and CO_2 research program since CO_2 accumulation may prove to be a "show-stopper" in terms of expanded fossil (but not biomass) energy alternatives. Additionally, the problem of acid rain is suggested as an important new area for emphasis by DOE.

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*FY81 funding/FY82 President's request in million $ are shown in parenthesis.

Materials Sciences ($95.2/$112.1) This program includes long-range research in solid state physics, materials chemistry, metallurgy and ceramics that is intended to provide a knowledge base that will lead to improved economics and performance of energy systems. Materials problems plague many energy production and conversion systems; a strengthening of this program would be a sound long-term investment since it addresses such important generic areas as high temperature alloys, corrosion, radiation damage and the physics and chemistry of surfaces. Increased operating costs of major facilities (such as neutron sources) has squeezed this program in recent years. Increased funding is recommended.

Climate and CO_2 Research ($12.9/$16.7*) ERAB members are in strong agreement on the importance of this program due to its long-term significance for public policy toward the use of fossil fuels. Although the predicted effects of increased CO_2 in the atmosphere occur well in the future, an intensified research effort is needed now in order to ensure that better information will be available for future decision making. The Federal Government clearly has the principal responsibility for research in this area; an increased effort is recommended.

Chemical Sciences ($69.0/$73.9) ERAB members are in general agreement that this program should be increased. The research supported is long-range and fundamental and addresses processes, interactions, and chemical transformations in liquids, gases and plasmas. Potential applications include developments ranging from new chemical catalysts for coal liquefaction to improved knowledge of combustion in automotive engines. Increased support in this area has recently been recommended by a detailed study of the Committee on Chemical Sciences of the National Research Council; ERAB concurs with that view.

Biological Energy Research ($7.7/$9.4) This program is designed to investigate the fundamental processes underlying plant biomass productivity and conversion of biomass to other materials for use as fuels or chemicals. ERAB members were generally in agreement that this program should be increased due to the long-term potential contribution from biomass and the small size of the present effort.

University Research ($11.8/$10.6) This program is primarily oriented toward improving the quality and quantity of scientific personnel in energy-related areas. This is clearly an area appropriate for Federal concern; an expanded program is recommended due to the modest level of the present effort.

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*Funded under Biological and Environmental Research. Excluded from Basic Energy Sciences budget.

Engineering, Math and Geosciences ($25.9/$32.3) Each of these areas of science, engineering, and mathematics is pertinent to energy and should be addressed by DOE programs. For example, the programs of the Atomic Energy Commission (AEC) were the first of the high technologies to rely effectively on computer modeling. For this reason, the AEC and its successor agencies, including DOE, have been the leading government agencies in supporting R&D in these areas. The DOE support should be targeted carefully toward those topics that are most obviously relevant to energy and correspond to scientific information needed by other DOE programs. In view of the importance of this effort, the present overall program is minimal.

Nuclear Sciences ($33.7/$37.9) This program includes research in low energy nuclear physics, actinide element chemistry and compilation of nuclear data relevant to the needs of the fission and fusion programs. It also supports the production, using unique federally funded facilities, and distribution of isotopes for medical and industrial use. The present funding level should suffice.

Advanced Energy Projects ($6.7/$8.2) This program identifies and tests the scientific feasibility of novel energy concepts. Particular attention is paid to proposed approaches that do not fit neatly in the scope of other DOE programs with the expectation that concepts that prove scientifically feasible and appear economically promising will be subsequently developed by other DOE programs or by private industry. In the view of ERAB, this program provides a worthwhile safety valve to ensure that promising ideas will not be ignored. The program should not be allowed to grow unduly at the expense of the higher priorities that have been identified, but should remain at about present funding levels.

Technical Assessment Projects ($9.5/$3.0) This program provides support for independent, objective analyses of R&D programs and needs and contributes to the overall planning effort of the Department. Present funding levels seem sufficient; expansion in this area is not needed.

D. Environmental Research

Biological and Environmental Research ($168.4/$170.5) This program investigates the potential human health and environmental impacts of new energy technology. It involves identifying the substances produced by energy systems, including such phenomena as acid rain; tracing their movement through air, water and land; and assessing their effects on humans and other living systems. Such research is clearly a Federal responsibility. It could not and should not be entrusted to private industry due not only to the long-term generic character of the work but also to the need for credibility and comprehensiveness. Certain unique

long-baseline programs in ecology and radiation effects can only be carried out under Federal auspicies. This program has been about level or reduced in recent years; an increase in funding is warranted.

ERAB recommends a change in program emphasis with a major, urgent concentration of effort to resolve the acid rain problem. The ability to increase the use of coal, particularly the high sulfur coals in the Eastern U.S., depends on a far better understanding of the causes as well as the impacts of acid rain. The information currently available raises as many questions as it seems to answer regarding the relation of coal-based emissions to the occurrence of acid rain. Thus, a major effort by DOE is in order to assure that future increased use of coal remains an acceptable option.

Environment and Safety ($48.5/$49.6) This program is designed to assess information concerning the environmental impacts of energy development, the safety impacts of various technologies, and the health and safety aspects of DOE and contractor facilities. Clearly, DOE must be concerned with the safety both of energy systems and of the facilities for which it is responsible.

E. Federal Role and the Energy Technology Base

The distribution of performer efforts for the DOE technology base program (government laboratories, universities, or industry) deserves reexamination and both ERAB and DOE have embarked upon studies that will culminate in recommendations on this score within a few months.

The high Federal role in these efforts is worthy of emphasis if the Nation's long-run energy needs are to be met. Industry conducts and will continue to conduct basic and applied research to serve its short-term economic needs, but interim economic incentives will always result in disjointed efforts from the national perspective. Only the Federal Government can assure a balanced approach for the longer run. The DOE research program also contributes to the technology base relevant to other national missions since advances in underlying knowledge can be widely applicable.

Finally, the reluctance of Congress, until now, to appropriate funds for the support of economic and social science studies relevant to energy demand usage and conservation has resulted in an incomplete DOE program for its technology base. ERAB again endorses the authorization and implementation of such programs in DOE.

November 1981

VIII. CONCLUSIONS AND RECOMMENDATIONS CONCERNING ENERGY R & D PRIORITIES

A. Overall R & D Program Priorities

Table VIII-A summarizes the results of the Board's evaluations of the four major energy R&D sectors: Electric supply, liquid and gas supply, conservation and utilization, and technology base. There are a number of electric-supply-related R&D programs that, for a variety of reasons, are of low priority and whose funding should either be substantially reduced or terminated. This reflects, in part, the Board's view that although no "correct balance among energy forms and resources can be defined a priori," R&D for electric supply technology is receiving a larger proportion of funding than the present and projected share of electricity in our national energy supplies.

The Board concluded that the overall Federal funding level in the liquid and gas R&D supply was higher than needed. This view results from the belief that the oil and gas industries are in a good position to take advantage of energy R&D opportunities and that the Federal Government role should be primarily focused on longer-term, higher-risk, applied research and development. It should not directly support costly demonstrations or large pilot plant projects (except as funded by loan or price guarantees through DOE and later under the Synthetic Fuels Corporation). However, great care should be taken in phasing out existing Federal R&D programs to insure technology transfer to the private sector.

In the conservation and end-use utilization area, the Board concluded that funding should be increased. The Board recognizes that higher energy prices have resulted in substantial reductions in energy demand and that this process is likely to continue. However, private enterprise in the buildings sector and, to a large degree, in the industrial sector is unlikely to do all the R&D needed. The Board believes that funds allocated to R&D in these two sectors should be increased. Such increases, combined with other ERAB recommendations, would increase the total allocation to the utilization and conservation technologies.

With regard to technology base programs, it was the Board's view that the funding for such programs should not be decreased and in certain areas should be increased. This stems from the Board's belief that, of all the sectors for energy R&D funding, the technology base programs are less likely to attract industry support; therefore, the Federal Government's role is greatest. Continued and increased support in the technology base programs offers the best chance for substantial technological break-throughs and improvements.

The remainder of this Chapter summarizes the conclusions and recommendations* of the Board in each of the Energy R&D program areas.

B. Electric Supply R&D Programs

With regard to Electric Supply R&D Programs, the major conclusions of the Board are as follows:

1. Continued emphasis is needed to complete the development and commercialization of light water nuclear power reactors in the U.S. A commitment has been made by this Administration to nuclear power. It has a significant role in the nation's energy mix; continued Federal support at this time is necessary. Hence, the Board recommends that continued funding be given to conventional reactor systems and safety, waste disposal programs (particularly accelerated demonstration), and uranium enrichment.

2. With respect to the liquid metal breeder reactor, research and development should be continued in order to maintain the capability for demonstrating breeder technology in the future. However, construction of a demonstration plant in the early 1980s is not an urgent national priority. Sufficient coal and uranium supplies exist to satisfy projected levels of electrical demand for at least 40 years and possibly well beyond. For these reasons, the panel recommends continued research and development on the liquid metal breeder reactor, as well as other breeder concepts, but that demonstration of breeder technology be delayed until a future time.**

3. With respect to fusion, ERAB members agree on the long-term importance of this program and that the primary Federal role should be to continue to sponsor a joint program of the federal laboratories, industry and university scientific communities to determine if fusion can be practical. The potential payoff is very large, but is much too far in the future for significant private sector support. There was agreement that a stretch-out of the program is possible if budgetary pressures demanded it, but maintenance of a substantial level of Federal R&D funding is judged to be essential. It is also recommended that an enhanced effort to examine the use of fusion for the breeding of nuclear fuels deserves consideration.

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*All funding recommendations are relative to the President's FY82 budget request.

**See dissenting opinion and additional remarks in Appendix D.

4. Finally, there are several electric programs for which funding should be reduced or eliminated (such as solar power technology, light water breeder reactors, electric transmission systems, geothermal, magnetohydrodynamics, and hydropower) due to their relatively small contribution to electric supplies in comparison with other programs.

C. Liquid and Gas Supply R&D Programs

With regard to Liquid and Gas Supply R&D Programs, the major conclusions of the Board are as follows:

1. With respect to enhanced oil and gas R&D recovery programs, the ERAB concluded that the U.S. oil and gas industry has sufficient resources and financial incentives to develop these technologies without substantial government assistance. The Board concluded that, even though these programs are important from the standpoint of urgency and energy security, the Federal R&D role should be minimal with less Federal funding needed.

2. With regard to coal liquefaction and coal gasification, it was concluded that large-scale demonstration projects involving substantial cost-shared Federal outlays are not necessary or appropriate considering the financial guarantees (e.g., loan guarantees, price guarantees) that are available from DOE and the Synthetic Fuels Corporation. The major Federal effort in synthetic fuels research and development should be directed at innovative concepts at the laboratory and small pilot-plant scale with particular emphasis toward exploring a wider range of technological options with potential for significant efficiency and cost improvements. The Board recommends a reduced budget for DOE's cost-shared projects at the large pilot plant and demonstration-plant scale.

3. With respect to in-situ oil shale recovery, the Board recommends a decrease in funding based on the fact that several major oil companies have in-situ shale projects that do not involve Federal assistance.

4. The funding level for R&D directed at producing liquids and gases from biomass and the production of alcohol is at an appropriate level.*

5. Continuing increases in the price of conventional oil and gas suggest that the time when coal and oil shale will be economic sources of oil may be near at hand. This situation is stimulating the private sector to consider some commercial operations by 1990. ERAB concludes that

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*See ERAB reports on Biomass and Alcohol Fuels.

the private sector can be expected to carry out important actions that justify a lessening of DOE research in these technologies. However, it is recommended that DOE accelerate its research in environmental problems and infrastructure problems associated with the commercialization of these technologies.

6. The bulk of the coal produced for the next several decades will be used directly as boiler fuel, both in existing and new units, reducing dependence on oil and gas for this purpose. But improved emission control technologies to reduce SO_x, NO_x and particulate emission in flue gases will be essential to the success of this effort. ERAB therefore urges that this part of the Advanced Research and Environmental Control Technology (FE) programs be increased and given higher priority at the expense of the other activities in this program.

D. Conservation and Utilization R&D Programs

With regard to Conservation and Utilization R&D Programs, the major conclusions of the Board are as follows:

1. The overall level of Federal R&D funding for conservation and improved utilization programs is too low in view of their potential for energy improvements and the inability of many important energy-consuming sectors to conduct R&D. Moreover, Department-wide, the balance between supply oriented R&D and conservation R&D is too heavily weighted toward the supply side.

2. The Board concluded that R&D in Buildings and Community Systems needs increased funding in view of the large amount of energy consumed in this sector and the lack of private sector institutions able to undertake building systems R&D. This is particularly true in the case of the important retrofit technologies.

3. R&D in the transportation sector should be redirected away from its present heavy emphasis on automobile engines and toward the heavy freight truck sector. The phase out should include a sharp reduction in work on the electric and hybrid vehicle.* Transportation systems utilization activities deserve support. Overall, funding levels in this area should remain the same.

4. Funding for the Multi-Sector Conservation program should remain the same and should be concentrated on work in the Energy Conversion and Utilization Technology program (ECUT).

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*See dissenting opinion in Appendix D.

5. Funding for the Industrial Conservation programs should be restored to approximately the level in FY81. Many industries have no capacity for private sector R&D and that the close cooperation with users that characterized this program deserves continuation.

6. Solar Applications for Buildings should be redirected slightly to emphasize passive heating and cooling. Solar pond and ice cooling technology should be continued since it is highly promising.

7. Funding for Solar Thermal Applications for Industry deserves slightly lower levels of support with redirection toward high temperature collector and dish technology development.

8. Funding for direct coal combustion systems (a high priority program), fuel cells, and heat engines and heat recovery should remain at the same levels.

E. Science and Technology Base Programs

The Board recommends increased Federal funding in a number of program areas. The Board would give particular emphasis to environmental and health-related research, clearly important from the standpoint of understanding and evaluating the long-term impact of the introduction of new energy technologies. Of particular importance are the CO_2 and acid rain issues. As previously indicated, the panel believes that the science and technology base programs should have a relatively higher Federal priority because of the lower likelihood that industry would provide adequate funds for such basic and applied research.

F. General Conclusions and Recommendations

1. Serious attention must be paid to several related environmental issues. First, development of nuclear waste disposal technologies and control technologies in the Advanced Research and Environmental Control Technology Program are necessary for environmentally sound implementation of present and future technologies. Second, several of the programs in the science and technology base are essential if a proper energy mix is to be employed. These include the acid rain program, the climate CO_2 program, and Health and Environmental Research.

2. Our energy system is a web of machines and people; the current budget is focused on machines. Consideration should be given to research in social areas, to prepare for rapid energy development in certain portions of the country and to help transfer conservation technologies for the industrial and residential sectors.

TABLE VIII-A

RELATIVE PROGRAM RANKING

Priority	Electric Supply		Fuel Supply		Conservation & Utilization		Science and Technology Base[1]	
	Program	Funding	Program	Funding	Program	Funding	Program	Funding
HIGHER							Materials Sciences	More
							Climate & City Research	More
							Chemical Sciences	More
	Commercial Nuclear Waste	Same					Biol/Environmental Research	More
							Biological Energy Sciences	More
					Coal Combustion	Same	Nuclear Medicine	Same
	Defense Nuclear Waste	Same			Buildings/Community Systems	More	High Energy Physics	Same
					Industrial Conservation	More	University Research	More
			Enhanced Oil Recovery	Less			Environment & Safety	Same
							Engineering/Math/Geosciences	Same
							Nuclear Physics	Same
MEDIUM	Conventional Reactors	More	Advanced Technology	Same	Transportation Conservation	Same		
			Enhanced Oil Recovery	Less	Solar Applications/Bldgs	Same		
	Breeder Fuel Cycle R&D	Little Less					Nuclear Sciences	Same
	Centrifuge	Same						
	LMFBR	Same			Heat Engines/Heat Recovery	Same		
			Coal Liquefaction	Less			Advanced Energy Projects	Same
	Solar Power Technology	Less			Multi-Sectors Conservation	Same		
	Advanced Isotope Separation	Same			Fuel Cells	Same		
			Biomass Energy	Same				
			[illegible]face Coal Gasification	Less				
LOWER			Mining R&D	Less	Solar Applications/Industry	Less		
	Magnetic Fusion	Little Less	In-Situ Oil Shale	Less			Technology Assessments	Same
	Light Water Breeder	Less						
	Uranium Resource	Same						
	Electric Energy/Storage	Less						
	Hydropower	Zero						
	Clinch River Breeder	Less						
	Geothermal	Less						
			Alcohol Fuels	Same				
			In-Situ Coal Gasification	Less				
	Magnetohydrodynamics	Zero						

[1]Science and technology base programs were evaluated by a different set of criteria from the R&D programs and are not directly comparable to them.

November 1981

APPENDIX A

Department of Energy
Washington, D.C. 20585

AUG 13 1981

Mr. Louis H. Roddis, Chairman
Energy Research Advisory Board
110 Broad Street
Charleston, S. C. 29401

Dear Lou:

The Department of Energy has invested heavily over the past several years in research and development on a wide range of energy alternatives. DOE now plans to increase emphasis on long-term, high-risk, and potentially high-payoff R&D programs. As such, it is timely to review our R&D priorities and to make some hard choices on which programs to pursue vigorously and which to deemphasize based on a realistic appraisal of both our energy options and energy needs for the foreseeable future. I would appreciate the advice of the Energy Research Advisory Board on these matters and particularly the Board's recommendations on overall Federal energy R&D priorities.

This effort can be based on the Board's broad knowledge of DOE programs and especially on the recent R&D panel activities to review the energy technology base and to develop criteria and methods for assessing priorities. Your terms-of-reference should include review and recommendations on the following concerns:

- The relative merits of each major R&D program with respect to such criteria as the technical and economic potential, urgency and lead time required, benefits and costs of Federal funding, contribution to energy security, health and environmental risks, and the appropriate Federal role;

- The appropriate R&D funding balance between electric power supply, fuels supply, conservation, and technology base program areas;

- The appropriate program orientation and balance between research, development, and demonstration activities;

- The strategic R&D objectives for the near-, mid-, and long-term.

Your thoughts on these matters would be particularly useful by November 16, 1981, to assist the Secretary and myself with our reviews of the DOE Sunset Report and the FY83 budget. However, I regard this as a continuing and important assignment for the Board and would also appreciate your recommendation on the next steps. Specifically, you should consider what efforts both ERAB and the Department should undertake toward improving our overall R&D planning, management, and evaluation processes and decisions. I will personally look forward to your report and hope to meet frequently with you and the Board as the study progresses.

Sincerely,

W. Kenneth Davis
Deputy Secretary

THE SECRETARY OF ENERGY
WASHINGTON, D.C. 20585

Appendix A

April 30, 1980

Dr. Solomon J. Buchsbaum
Executive Vice President
Customer Systems
Bell Laboratories
Crawford Corner Road
Holmdel, New Jersey 07733

Dear Dr. Buchsbaum:

Research and development to increase the supply, conversion efficiency and conservation of energy is vital to our national interest. I am particularly concerned about the adequacy of the Department's efforts in this area. The Department is presently undertaking a review of the technology base component of our R&D programs under the leadership of the Director of Energy Research with a view toward improving their effectiveness. I would appreciate the participation of ERAB in this process in order to give us the benefit of external views on the adequacy of these programs.

There are some broad concerns that need to be addressed:

- The adequacy of the research underpinning for technology development programs.
- Possible gaps or duplications of effort.
- The balance among research performers (universities, laboratories, industry).
- Significant R&D opportunities that our programs may be missing.

Obviously, a complete review of this whole area would be a lengthy and complex task and I view this as a continuing effort through which ERAB might help the Department. In the shorter term, an initial review of the technology base in conjunction with the work Ed Frieman already has underway could be helpful in contributing to our final decisions on the FY 1982 budget if it could be completed by the end of the summer. I hope that ERAB can devote a portion of its summer study to this task.

Sincerely,

John C. Sawhill
Deputy Secretary

APPENDIX B: BACKGROUND INFORMATION

CHRONOLOGY OF R&D PANEL MEETINGS[1] APRIL 30, 1980 TO NOVEMBER 5, 1981

1. Planning and Implementation

On April 30, 1980, Deputy Secretary John C. Sawhill requested ERAB to review the R&D programs in the Department. An initial review of the technology base in conjunction with the work the ER Director had underway would be helpful in contributing to the final decision on the FY 82 budget. ERAB approved the terms of reference and established a panel.

On June 7, 1980, the R&D Panel met to formulate questions and issues for Panel consideration, to develop outlines for Panel and Subpanel reports, and to discuss organizational matters. The Panel also approved an agenda for the first full-scale Panel and Subpanel organizational meetings to be held.

2. Technology Base Assessment and Detailed Program Reviews

On July 10, 1980, the Fossil R&D Subpanel met in Washington to receive briefings on fossil energy technology and R&D programs, review DOE's documents on technology base assessment, and discuss preparation of the initial draft input to final R&D Panel report.

On July 10th and 11th, 1980, the Conservation R&D Subpanel met in Washington, was briefed on conservation technology and R&D programs, and held initial discussions on Conservation Subpanel input into ERAB Technology Base Report.

On July 22, 1980, the Nuclear R&D Subpanel met in Washington for a summary of fact-finding briefings on nuclear technology and R&D programs. They discussed eight items pertaining to the technology base assessment of DOE's Nuclear R&D programs.

- Converter Reactor Systems
- Commercial Nuclear Systems
- Advanced Nuclear Systems
- Spent Nuclear Fuel
- Breeder Reactor Systems
- Advanced Isotope Separation Systems
- Nuclear Uranium Assessment
- Gas Centrifuge

1/ All meetings were open to the public with notice in Federal Register.

On July 23, 1980, the Solar R&D Subpanel met in Washington for briefings on solar technology and R&D programs to review DOE documents on the technology base component of DOE's Solar Energy R&D program and to hold initial discussions on Solar Energy R&D Subpanel input into the ERAB Report.

On July 23, 1980, the Energy Research R&D Subpanel met in Washington for briefings on Basic Energy Sciences and other energy research programs and to review the technology base research support by the Office of Energy Research.

On July 29, 1980, the Environment R&D Subpanel met in Washington for discussions on the status of technology base assessment. Representatives from the research offices within DOE Office of Environment discussed highlights of their programs. Office of Technology Impacts discussed the complexity of doing good assessments stressing the problems of the data collection and management.

On July 29, 1980, the Resource Applications R&D Subpanel met in Washington for briefings on resource application programs to review DOE documents on the technology base component of DOE's Resource Applications R&D Program, and to hold initial discussions on Resource Applications R&D Subpanel's input into ERAB Technology Base Report.

On July 30th and 31st, 1980, the R&D Panel met in Washington for discussions on crosscutting issues and integration problems. Subpanel members discussed status of membership, information needs, plans to complete reports and planned for activities at La Jolla.

3. Interim Report on DOE Technology Base "R&D Needs in DOE"

On August 18th, 1980, the Board met as a whole, then divided into their individual subpanels to complete the initial phase of the study and report to the full ERAB during the course of the meeting.

On August 18th - August 22nd, 1980, the ERAB Summer Study meetings were held to develop an interim report, findings, conclusions and recommendations on the technology base assessment (TBA) study. The following seven (7) subpanels were involved

8/19/80 - R&D Integration Panel - La Jolla
8/19-21/80 - Energy Research R&D Subpanel - La Jolla
8/21/80 - Resource Applications R&D Subpanel - La Jolla
8/19/80 - Solar R&D Subpanel - La Jolla
8/18-20/80 - Environment R&D Subpanel - La Jolla
8/18-20/80 - Nuclear R&D Subpanel - La Jolla
8/19-21/80 - Fossil R&D Subpanel - La Jolla

In addition, ERAB conducted several in-depth technical reviews which were also used as a basis for the R&D priorities study. Specifically, ERAB conducted studies on: (1) Efficient Use of Energy (Conservation); (2) Fossil Energy; (3) Nuclear Energy; (4) Solar Energy; (5) Resource Applications; (6) Environment; and (7) Energy Research.

On August 22, 1980, the ERAB Board in La Jolla received the draft TBA report and approved it subject to incorporation of the members' revisions. The report was subsequently transmitted to the Secretary of Energy as an interim report on 9/5/80 (Research and Development Needs in the Department of Energy).

4. Methodology for Setting R&D Priorities

On December 19, 1980, the R&D Panel met in Washington to discuss a methodology for evaluating energy R&D priorities. Discussions were held on alternative approaches to implementing R&D Priorities Study proposed in Bill McCormick's "White Paper," suggesting the R&D needs exercise should be expanded to set overall priorities and trade-offs between R&D program areas based on consistent criteria.

On January 26, 1981, the R&D Panel met in Cleveland to dicuss the methodology for evaluating energy R&D priorities. Discussions were held to reveiw methodology for ranking priorities and structure of Panel/Subpanels. Other topics discussed were:

Membership, Technical Support Group
Definition of Criteria
Weight/Value Functions
Input, Value Judgments, and Outputs (by Subpanel)
Technology Lists
Schedule
Report Outlines

5. R&D Priorities and Study Report

At the February 5-6, 1981 ERAB meeting, discussions were held on the recent activities of the R&D Panel and alternate approaches. It was proposed that a number of subpanels could be formed to provide input on energy technologies and one which is to cover technology base and environmental considerations. Several energy product subpanels would then utilize input from the foregoing subpanels. The plan also included possible utilization of the MARKAL computer model developed by BNL.

At the July 9-10, 1981 ERAB meeting, John Foster, Chairman of the Panel, reviewed their past efforts beginning with the Interim Report transmitted to the Department last September, following an extensive effort culminating in the Summer Study meeting in August 1980.

APPENDIX B

On August 13, 1981, Deputy Secretary Kenneth Davis requested advice of the Energy Research Advisory Board on the R&D priorities and the Board's recommendations on the overall Federal energy R&D priorities.

The Panel was in the process of developing a methodology which would assist in assigning priorities to the nation's energy R&D programs, and would also help to illuminate the appropriate role of the Federal Government in these programs. For the purposes of the R&D priorities study, the R&D Panel would consist of all the members of ERAB with an Executive Committee appointed by the Chairman to include John Foster (Chairman, R&D Panel), William McCormick (Vice Chairman, R&D Panel), Lou Roddis (Chairman of ERAB), and Ivan Bennett (Vice Chairman of ERAB). Whether additional Panel members would be appointed would be decided at a later date; previous subpanels to the R&D Panel were dissolved.

At the September 2-3, 1981 ERAB meeting, the Chairman reported on the progress and current status of the R&D study and noted the August 13 letter request from the Deputy Secretary which sets the framework for it. The Deputy had asked that the report be completed by mid-November. John Foster, R&D Panel Chairman, described in detail the activities of the Panel, the methodology they were applying, and the evaluation forms each member will be asked to complete and return for collation. He urged each member to include any narrative comments along with their program evaluations which would serve to explain any particular rating made by a member and serve as a basis for drafting the report.

A detailed discussion then followed among all ERAB members in an attempt to establish a uniform basis among them all for their responses. These responses were discussed at a special meeting of the Panel on September 24. Preliminary results were sent to members on October 1. ERAB members submitted respective subsection drafts October 15, and a draft of the report was sent to ERAB members by October 30. The final review took place at the ERAB meeting on November 4-5.

On September 24, 1981, the R&D Panel met in Washington to discuss a number of cases in which overall programs were not highly rated, but individual aspects of subprograms of the major program were essential. The Panel concluded that considerations for subprograms of the major programs, particularly those involving subprogram funding recommendations, should be highlighted by discussion in the narrative portion of its report.

The initial results of the prioritization study were discussed at the Energy R&D Panel Meeting held September 24, 1981, in Washington, DC. At that meeting consensus recommendations were reached concerning funding where no consensus had resulted from the raw data evaluation. It was recognized that the final priority ratings would be the result of an evaluating process.

APPENDIX B

TABLE B-1

ENERGY R,D&D PROGRAM BUDGET SUMMARY

	Congress. Budget Authority FY1981	Pres. Request FY1982	Congress. Budget Authority FY1982
	(in $thousands)*		
A. Electric-Related Supply			
1. Magnetohydrodynamics (FE)	66,533	0	29,000
2. Geothermal (CE)	153,645	46,775	57,775
3. Hydropower (CE)	2,409	0	2,750
4. Electrical Energy Systems and Energy Storage Systems	109,800	47,525	65,625
5. Solar Power Technology (CE)	112,100	19,400	73,800
6. Magnetic Fusion (ER)	391,000	456,100	484,600
7. Uranium Resource Assessment (NE)	25,925	5,800	5,800
8. Uranium Enrichment (NE)			
a-Centrifuges (NE)**	356,315	760,300	691,800
b-Advanced Isotope Separation (NE)	79,300	85,237	85,237
9. Conventional Reactor Systems (NE)	81,500	68,000	101,750
10. Breeder Reactors (NE)			
a-Liquid Metal Fast Breeder Reactor	371,919	387,842	405,628
b-Clinch River Breeder Reactor	172,000	254,000	228,000
c-Light Water Breeder	60,200	58,000	45,000
d-Fuel Cycle R&D	47,500	26,100	48,100
11. Nuclear Waste			
a-Commercial (NE)	201,415	227,551	208,701
b-Defense (DP)	298,445	390,000	384,800
12. Mining R&D (FE)	40,169	21,000	17,000
Subtotal	2,570,175	2,853,630	2,935,366
B. Liquids and Gas-Related Supply			
13. Advanced Technology (FE)	95,761	94,500	84,500
14. Coal Liquefaction (FE)	276,997	105,200	248,200
15. Surface Coal Gasification (FE)	69,618	53,440	56,300
16. In Situ Coal Gasification (FE)	9,960	8,300	8,300
17. Enhanced Oil Recovery (FE)	16,158	20,100	20,100
18. Enhanced Gas Recovery (FE)	30,598	10,200	14,200
19. In Situ Oil Shale (FE)	32,151	16,250	22,350
20. Biomass Energy (CE)	31,650	20,500	20,500
21. Alcohol Fuels (CE)	18,000	10,000	10,000
Subtotal	580,893	338,490	484,450

* Includes deferrals and rescissions, but excludes program direction.

** Includes $293.3M in FY 81 and $695.8M in FY 82 for construction of gas centrifuge plant.

TABLE B-1 (continued)

		Congress. Budget Authority FY1981	Pres. Request FY1982	Congress. Budget Authority FY1982
		(in $thousands)*		
C.	Conservation & Improved End-Use Utilization			
22.	Coal Combustion Systems (FE)	37,368	38,800	42,800
23.	Heat Engines & Heat Recovery (FE)	31,468	15,600	15,600
24.	Fuels Cells (FE)	32,012	28,600	35,900
25.	Buildings & Community Systems (CE)	52,990	28,000	47,400
26.	Industrial Conservation (CE)	67,300	0	29,600
27.	Transportation Conservation (CE)	102,120	37,000	59,550
28.	Multi-Sector Conservation (CE)	25,800	17,500	19,600
29.	Solar Applications for Buildings (CE)	224,900	84,700	118,050
30.	Solar Applications for Industry (CE)	138,270	44,000	66,050
	Subtotal	712,228	294,200	434,550
D.	Technology Base			
31.	Energy Supporting Research (ER)			
	a-Basic Energy Sciences			
	aa-Nuclear Sciences	33,700	37,670	37,670
	ab-Materials Sciences	95,150	112,060	112,060
	ac-Chemical Sciences	69,040	73,940	73,940
	ad-Engineering, Math & Geosciences	25,860	32,300	32,300
	ae-Advanced Energy Projects	6,650	8,220	8,220
	af-Biological Energy Sciences	7,650	9,410	9,410
	ag-CO_2 and Climate Research**	12,900	16,700	0
	b-Technology Assessments	9,500	3,000	3,000
	c-University Research	11,800	10,500	10,600
32.	General Science (ER)			
	a-High Energy Physics	348,180	392,700	392,700
	b-Nuclear Physics	109,200	122,900	122,900
	c-Nuclear Medicine	45,900	50,500	50,500
33.	Environment & Safety (EP)	48,510	49,600	43,600
34.	Biological & Environment Research (ER)**	155,272	153,800	176,500
	Subtotal	979,312	1,073,400	1,073,400
	TOTAL	4,842,600	4,559,220	4,927,766

*Includes deferrals and rescissions, but excludes program direction.

**The biological and environmental research program includes climate and CO_2 research with a total budget of $168,172 in FY1981 and $170,500 in FY1982.

TABLE B-2

TIME OF EXPECTED IMPACT

PROGRAMS	TIMEFRAME OF IMPACT*		
	Near	Mid	Long
A. Electric-Related Supply			
1. Magnetohydrodynamics (FE)		X	
2. Geothermal (CE)	X		
3. Hydropower (CE)	X		
4. Electrical Energy and Storage Systems (CE)		X	
5. Solar Power Technology (CE)		X	
6. Magnetic Fusion (ER)			X
7. Uranium Resource Assessment (NE)	X		
8. Uranium Enrichment (NE)			
a- Centrifuge (NE)	X		
b- Advanced Isotope Separation (NE)		X	
9. Conventional Reactor Systems (NE)	X		
10. Breeder Reactors (NE)			
a- Liquid Metal Fast Breeder Reactor			X
b- Clinch River Breeder Reactor		X	
c- Light Water Breeder Reactor			X
d- Fuel Cycle (R&D)			X
11. Nuclear Waste			
a- Commercial (NE)	X		
b- Defense (DP)	X		
B. Liquids and Gas-Related Supply			
12. Mining R&D (FE)		X	
13. Advanced Research Tech. Development (FE)		X	
14. Coal Liquefaction (FE)		X	
15. Surface Coal Gasification (FE)		X	
16. In Situ Coal Gasification (FE)			X
17. Enhanced Oil Recovery (FE)	X		
18. Enhanced Gas Recovery (FE)	X		
19. In Situ Oil Shale (FE)			X
20. Biomass Energy (CE)	X		
21. Alcohol Fuels (CE)	X		
C. Conservation & Improved End-Use Utilization			
22. Coal Combustion Systems (FE)		X	
23. Heat Engines & Heat Recovery (FE)		X	
24. Fuels Cells (FE)		X	
25. Buildings & Community Systems (CE)	X		
26. Industrial Conservation (CE)	X		
27. Transportation Conservation (CE)		X	
28. Multi-Sector Conservation (CE)	X		
29. Solar Applications for Buildings (CE)	X		
30. Solar Applications for Industry (CE)	X		
D. Science and Technology Base			X

APPENDIX C: DESCRIPTION OF METHODOLOGY

1. Overview Description of Methodology

The methodology used in this study can be summarized as follows. The list of RD&D programs to be prioritized was agreed upon and then each program was placed into one of four end-use areas: electric-related supply, liquids- and gas-related supoly, conservation and utilization, and science and technology base programs (see Table C-1). Criteria to be used in assessing the technology priorities were selected and the definitions for each criterion agreed upon. Two sets of criteria were developed--one set of seven for the R&D programs and one set of five for the Science and Technology Base programs (see Tables C-2 and C-3).

It is important to note that the assessment or evaluation process involving the decision questionnaires which each member was asked to complete were not intended to and would not "fix" the results of the final priority ratings but were designed as an initial point of departure from which final conclusions would ultimately evolve--conclusions which may or may not be consistent with the initial ratings.

Each member of the R&D Panel was asked to make two assessments. The first was used to determine each individual's view concerning the relative importance of criteria for R&D programs and for Science and Technology Base programs. Each criterion was judged "very important" (value of 3), "reasonably important" (value of 2), or "slightly important" (value of 1) relative to Federal energy R&D priorities. A consensus weighting for reach criterion based on the average of all responses was calculated and then normalized to a value of one. The second form was the program evaluation form. For each criterion for each technology the members judged whether that criterion had a high (value of 3), medium (value of 2) or low (value of 1) importance. In addition each member was asked to state a recommended program funding level for each technology, his or her perceived level of knowledge concerning each technology, and any comments he or she wished to make concerning each technology.

The above information was then used to calculate figures of merit (FOM) for each technology. On the basis of the FOM the technologies were then ranked. The funding information was used as the basis for recommendations of future funding--namely, whether the funding for each program should be decreased, remain the same or be increased relative to the President's FY82 budget.

APPENDIX C

TABLE C-1

R,D&D PROGRAMS

Energy Related Supply Programs
- Magnetohydrodynamics (FE)
- Geothermal
- Hydropower
- Electric Energy & Storage Systems
- Solar Power Technology (CE)
- Magnetic Fusion (ER)
- Uranium Resources Assessment (NE)
- Uranium Enrichment - Centrifuge (NE)
- Uranium Enrichment - Advanced Isotope Separation (NE)
- Conventional Reactor Systems (NE)
- Liquid Metal Fast Breeder Reactor
- Clinch River Breeder Reactor
- Light Water Breeder Reactor
- Fuel Cycle R&D
- Nuclear Waste - Commercial (NE)
- Nuclear Waste - Defense (DP)

Liquids and Gas Related Supply Programs
- Mining R&D (FE)
- Advanced Technology (FE)
- Coal Liquefaction (FE)
- Surface Coal Gasification (FE)
- In Situ Coal Gasification (FE)
- Enhanced Oil Recovery (FE)
- Enhanced Gas Recovery (FE)
- In Situ Oil Shale (FE)
- Biomass Energy (CE)
- Alcohol Fuels (CE)

APPENDIX C

TABLE C-1 (continued)

Conservation and Improved End-Use Utilization Programs

- Coal Combustion Systems
- Heat Engines and Heat Recovery
- Fuel Cells (FE)
- Buildings & Community Systems
- Industrial Conservation
- Transportation Conservation
- Multi-Sectors Conservation (CE)
- Solar Applications for Buildings
- Solar Applications for Industry (CE)

Science and Technology Programs

- Energy Supporting Research (Overall)
- Basic Energy Sciences (Overall)
- Nuclear Sciences
- Materials Sciences
- Chemical Sciences
- Engineering, Math & Geosciences
- Advanced Energy Projects
- Biological Energy Sciences
- Climate and CO_2 Research
- Technology /Assessments
- University Research
- General Science (Overall)
- High Energy Physics
- Nuclear Physics
- Nuclear Medicine
- Environment and Safety
- Health & Environmental Research

APPENDIX C

TABLE C-2

EVALUATION CRITERIA FOR ENERGY R,D&D PROGRAMS

1. Technological Potential/Risk

Definition: Likelihood that the R,D&D Program will, within a reasonable period of time, result in technical success.

High (3) - Very good likelihood of technical success. (in other words, low technical risk)

Med. (2) - Reasonable chance of technical success. (in other words, moderate technical risk)

Low (1) - Only a slim chance of technical success. (in other words, high technical risk)

2. Urgency

Definition: Considering both the time period before which the technology is needed and the lead time for development, how urgent is the R,D&D program.

High (3) - Program must be started now (or continued) at a high level of effort.

Med. (2) - Program could be carried on at a moderate level now or, alternatively, delayed for 5 years or possibly 10 years.

Low (1) - There is no urgency in the program and it could be delayed for 10 years or more.

3. Economic Potential

Definition: Likelihood that the technology, when it is developed, will be economically competitive with then existing technologies providing energy in the same form or available alternative substitutable sources (note: assume development is completed no later than the year 2000).

High (3) - Economics are likely to be very competitive.

Med. (2) - Economics are uncertain or are likely to be marginally competitive.

Low (1) - Economics are likely to be non-competitive.

4. Benefit/Cost

Definition: Considering the size of the R,D&D investment needed to develop the technology, how substantial is the impact of the development of the technology in terms of end-use energy produced or saved.

High (3) - Less than $1 billion of total R,D&D investment required for each 1 Quad of energy produced or saved annually (in the year 2000).

Med. (2) - Between $1 billion and $10 billion of total R,D&D investment for each 1 Quad of energy produced or saved annually (in the year 2000).

Low (1) - More than $10 billion of total R,D&D investment for each 1 Quad of energy produced or saved annually (in the year 2000).

5. Energy/National Security

Definition: How significant is the energy technology from the standpoint of displacing or substituting for insecure foreign energy sources (primarily oil).

High (3) - Will displace or substitute for 2.0 million barrels/day or more (about 4 quads/yr) or oil equivalent by the year 2000.

Med. (2) - Will displace or substitute for 0.5 to 1.99 million barrels/days of oil equivalent by 2000.

Low (1) - Will displace or substitute for less than 0.5 million barrels/day of oil equivalent by 2000.

6. Safety, Security, Health and Environmental Impact

Definition: Both from the standpoint of the general public and the worker, the degree to which the technology is safe, secure, healthy and has minimal (or even positive) environmental impacts.

High (3) technology results in improved safety, health and environmental impact.

Med. (2) technology would have some adverse safety, health or environmental consequences, but not serious ones considering potential control measures.

Low (1) technology has serious safety, security, health or environmental problems.

7. Federal RD&D Role

Definition: considering the RD&D support for the technology that is likely to come from industry, how important to timely commercialization is Federal RD&D support.

High (3) - heavy Federal support is essential since because of the risk or long development period, industry support will be small.

Med. (2) - some Federal support is needed to complement industry efforts or to ensure timely development.

Low (1) - little or no Federal support is needed since industry efforts are likely to be adequate.

APPENDIX C

ADDITIONAL EVALUATION CRITERIA FOR SCIENCE AND TECHNOLOGY BASE PROGRAMS

Most of the above criteria are not directly applicable to evaluating DOE Technology Base programs. The benefits of these basic and applied research and engineering development activities must be measured against different criteria for obvious reasons. The following criteria are to be used for evaluation of the science and technology programs listed in Attachment 4D:

8. Scientific Potential

Definition: degree to which the research program will advance scientific knowledge or contribute toward maintenance of American scientific leadership and achievements in a respective field and, therefore, represents an important national trust.

High (3) - Very likely to produce significant advances in scientific knowledge on important new frontiers of science.

Med. (2) - likely to add substantially to fundamental knowledge in relatively developed and mature fields.

Low (1) - not likely to add substantially to new knowledge.

9. Inventive Potential (Risk/Benefit)

Definition: likelihood that the R&D program will over the long term directly produce breakthroughs, discoveries, or inventions in energy production, usage, or conservation which have significant economic, social or environmental benefits and, thereby, justify the risks/costs of the applied science and engineering research efforts.

High (3) - very likely that the R&D program will directly result in energy developments with significant economic, social, or environmental benefits over the long-run.

Med. (2) - likely that the program will at least break even in producing energy developments with economic, social, and environmental benefits over the long-run.

Low (1) - not likely to produce energy developments with direct economic, social, or environmental benefits.

10. Mission Impact

Definition: degree to which the R&D program supports or underwrites the success of DOE technology development programs by providing the technology base for understanding fundamental working properties of the technology, solving known and unanticipated engineering development problems, and transferring new engineering knowledge to other energy applications and missions.

High (3) - program provides essential research and engineering support for critical energy technology development missions and goals.

Med. (2) - program provides general support with widespread applications to technology development missions or areas with less critical problems or secondary missions.

Low (1) - program does not directly support technology development programs, but may have general applications.

The following two RD&D program criteria are applicable to the science and technology base programs and are to also be used in evaluating the science and technology base programs.

2. Urgency

Definition: same as RD&D criterion Number 2 above

7. Federal Role

Definition: same as RD&D criterion Number 7 above

APPENDIX D

ENERGY RESEARCH ADVISORY BOARD DISSENT TO RECOMMENDATIONS WITH RESPECT TO CLINCH RIVER BREEDER REACTOR

EXECUTIVE SUMMARY

Cancellation of the Clinch River Breeder Reactor Project at this time would not only result in time loss of investment of over $1 billion already incurred to date, but would also dissipate the hard-won technology capability already developed in the U.S., probably for the remainder of the century. Even if one accepts the argument that the breeder reactor program would only provide a useful option for energy generation sometime in the future, it is still necessary to complete the Clinch River Project in order to actually demonstrate this technology in the U.S. licensing and safety environment. Proven technology does not exist without an actual demonstration of acceptable safety, reliability, and operability. Although it is obvious from the achievements of the French, Japanese, British and Russian programs that sodium-cooled fast breeder reactors are practical, it has not been demonstrated that such plants can be designed, built and operated by U.S. technology and industry within the constraints imposed by domestic safety and licensing standards. The consideration of technology demonstration and preservation of U.S. presence in the worldwide breeder development program requires that the CRBR project be rapidly completed.

BASIS OF DISSENT

The energy future of the U.S. is subject to so many variables that no one can adequately predict what course the future will take with respect to energy. We do not know with any certainty how much energy will be used in 2000, for example, or what effect this will have on the growth of our economy.

It is also far from clear what quantities of the various fuels will be available. The U.S. must be prepared to cope with such undesirable events as partial or total cut-off of imported oil.

Electricity is a uniquely flexible form of energy. The transmission and distribution systems can be used to accommodate any source of generation, thus utilizing the energy source available at the time. The electricity can be transmitted to almost any desired point of use. This would be particularly useful in the event of disruption of energy sources due to any cause including enemy action.

APPENDIX O

The most available sources of energy, coal and uranium, can be best used to produce electricity. A larger part of U.S. energy needs could be supplied by electricity. It could be used for almost all space heating and provide much of the process energy required. This could be done in a more energy efficient and environmentally satisfactory way by the use of heat pumps.

It is predicted by the DOE that from 36 to 50 percent of the primary energy in 2000 will be used for the generation of electricity. It is probably possible to accomplish this, almost entirely by burning coal, but it almost certainly would not be the optimum choice on either economic or environmental grounds. There are clearly some undesirable health effects from burning coal and these should be minimized.

If one assumes that the upper end of the DOE 2000 LWR capacity projection of 200 GW occurs, this would require committing about 50 GW between now and 1990. Most, if not all of these reactors would be committed between 1985 and 1990. If there is about 900 GW of generating capacity in 2000 and the growth rate is 3.5 percent per year, then 31.5 GW plus replacements will be committed per year by 1990. It would seem reasonable for the nation to be in a position to have as much as 20 GW per year by nuclear plants. While it is possible that many of these plants could be coal burning, there are enough potential problems with coal plus the possible economic advantages of nuclear, that we should be able to take advantage of that option. This might amount to 243 GW of nuclear plants being committed between 1990 and 2000.

A 3.5 percent growth rate after 2000 would required additional capacity of about 540 GW, plus replacements, to be committed for operation by 2020. If half of this is LWR's then by 2010 about 4.6 million tons of uranium would have been committed for a 30 year life. If the life is 40 years, then 4.9 million tons would have been committed by 2010. (With a 40 year life there would be fewer replacements by 2020.)

According to a recent DOE report, there is a 95 percent confidence that there is 3,875,000 tons of U_3O_8 in the U.S., at a forward cost of $100 per pound. This includes reserves as well as probable, possible and speculative reserves.

Forward costs are operating and capital costs in 1980 dollars that would be incurred in producing the uranium; they exclude income taxes, profits, cost of money and sunk costs. The market price that would support a 15 percent rate of return has been estimated to be 1.4 - 1.6 times the forward cost per pound of U_3O_8.

It should be remembered that if there is the demand for uranium that approaches the amount potentially available the price rises accordingly.

The U.S. also has to a considerable degree a contractual, political and moral obligation to supply a considerable amount of uranium to industrial and developing nations.

The breeder should start being deployed in a significant way by 2010 or before as it is by no means assured that we would otherwise have the uranium required.

If reactors can be built in the time that is technically possible and if fewer design changes are made during construction, costs can be drastically reduced. This would make them the clear choice from the point of view of economics. To be able to take advantage of this may require deployment of breeders by 2010.

Even if breeders are not required due to the lack of uranium for LWR's, it may well be desirable to deploy them on economic grounds. The economics of the LMFBR compared to the LWR using break-even analysis has been extensively examined by various U.S. groups. The majority conclusion is that the break-even could occur around the year 2000 at an equivalent 30 year levelized price of uranium of about $50 - $150 per pound, in 1980 dollars.

The capital cost of breeders is higher than that for LWR's but the fuel cost is lower. This provides a good hedge against inflation as the capital costs will be a larger fraction of the kilowatt-hous cost and will remain constant. The longer the lifetime used in the evaluation, the more favorable for the breeder.

Recent cost benefit studies, using econometric models, have shown that benefits measured in hundreds of billions of dollars would accrue from early as opposed to late introduction of the LMFBR.

There has been no even marginally commercially successful reactor without a previous demonstration plant having been built. Those involved with the reactor development program believe that a demonstration plant is essential. There will be many things that will not work as well as would be desired when they are put together in a complete reactor system. The information learned from such a demonstration will lead to far better second and subsequent generation plants.

No U.S. reactor has even been built with a single scale up as large as would be represented by the scale up from FFTF to a 1000 MW reactor.

The major reason for success in both the Naval nuclear and the LWR program was that in each case there was a reactor being built which provided a focus for the research effort.

The refocusing of a broad range R&D program, even one already focused on the needs to build a plant, will be greatly improved as the result of data obtained in the design, construction and operation of a demonstration plant.

One of the principal reasons for the success on the LWR's has been the infrastructure, suppliers of equipment and services, that had been created and nurtured. Cancellation of the CRBR will cause a break in the industry continuity and many suppliers may be reluctant to get back into the breeder business.

If CRBR is not continued, then it will have to be replaced by another demonstration plant. The size could be somewhat but not much larger. This would require many additional years and far more money. If CRBR is completed the next plant can be built for considerably less than it would otherwise cost.

To date, there has been $1.148 billion spent on CRBR, $246 million of components have been delivered and $352 million more are on order. There are 3200 people working on this project and design is 86 percent completed.

The design of CRBR is as advanced as any in the world. The design techniques and safety studies are more advanced than those in any other country. The CRBR can accommodate changes required to demonstrate the LMFBR system, including alternate fuel systems.

In fact, the recently completed conceptual design study (CDS) by the DOE which assumes construction and operation of CRBR, contains relatively modest changes to the basic CRBR design. For example, the 1000 MW CDS plant would have the same core and IHX design concepts, and its containment would be based on the same design philosophy as CRBR.

Although the fuel handling systems of each plant are quite different, other CDS reactor components only reflect modest extension of CRBR design experience, such as reactor vessel piping with internal downcomers; shutdown heat removal system within the reactor vessel; four loops vs three; two stage coolant pump which retains the hotleg feature of CRBR; and flexibility to accommodate any one of three steam generator designs.

The CRBRP will serve as an important step in beginning the transition of the fast breeder reactor program from the technology development stage to the decision point of large-scale commercial utilization. The major objectives of the project are: 1) to demonstrate the technical performance, reliability, maintainability, safety, environmental acceptability and economic feasibility of the LMFBR central station electric power plant in a utility environment, and 2) to confirm the

value of this concept for conserving important non-renewable natural resources.

Although paper studies, laboratory experiments, and component testing are essential steps in developing complex new technology, only the practical demonstration of the fully integrated systems can move it nearer to readiness for commercial use. The history of light water reactor development suggests that CRBR would be the first of probably two demonstration plants built in tandem before there can be sufficient investor confidence to make commercial deployment possible. Such tandem demonstrations will require about 25 years for design, licensing, construction, testing and demonstration of operating reliability and maintenance requirements. This would bring us to about the year 2007 before our nation is postured to commit additional breeders that would then begin to make their first energy contribution in about 2020. If Clinch River should be terminated, the entire program will stretch out at least an additional ten years.

With the risks of oil supply, the uncertainties of the environmental acceptability of massive additional use of coal, and the unknown about future uranium for LWR's, our nation can ill afford the risk of arriving at 2007 and not have the capability to deploy the breeder. It may not be needed until later, but if it should be needed then and not available, the consequences could be severe. Breeders will multiply the energy recoverable from our nation's uranium reserves by a hundredfold or more.

In dissenting from the majority vote of ERAB, the undersigned also feel that Clinch River suffered from the criteria used in voting and weighing procedures. Clinch River cannot possibly save energy by 2000, it will not replace oil by then, it has no economic potential during this century, all of which cause CRBR to receive low ratings in these categories. We do feel that it is an essential and integral part of the on-going LMFBR program which received high ratings, and CRBR should proceed with dispatch.

Respectfully submitted: John W. Simpson
Roland W. Schmitt
William S. Lee
Louis H. Roddis

APPENDIX D

ENERGY RESEARCH ADVISORY BOARD
ADDITIONAL REMARKS BY THOMAS B. COCHRAN
WITH REGARD TO THE CLINCH RIVER BREEDER REACTOR

In its initial evaluation of DOE energy R&D programs, at least two-thirds of the members of the ERAB agreed that the Clinch River Breeder Reactor (CRBR) has low urgency, low economic potential, low benefit-to-cost ratio and that funding should be reduced. In the final analysis three-quarters of the ERAB members recommended that the "[breeder reactor] demonstration be delayed until a future time" -- a statement which clearly implies termination of the present CRBR project.

Four ERAB members have attached a six page dissent to the five sentences devoted to the CRBR*/ in this 46 page report, which evaluates 49 program areas covering all DOE energy R&D. Under normal circumstances, the report of the majority should respond to the points raised by the minority. Because ERAB was under an extremely tight schedule to complete this exercise, no time was made available to provide for a majority discussion of the minority view. Consequently, the following comments by one member of the majority are presented in order to provide some balance to the discussion of the CRBR issue.

URANIUM SUPPLY

In order to counter the majority view that "sufficient... uranium supplies exist to satisfy projected levels of electric demand for at least 40 years and possibly well beyond" (p. 43), the minority states that "no one can adequately predict what course the future will take with respect to energy" and then proceeds to present its own high nuclear growth scenario**/ This has the effect of exhausting low cost uranium resources sooner than otherwise projected, thus making an earlier commitment to a breeder demonstration plant more persuasive.

The simple response to this argument is that when one is not ordering any new reactors, one is not going to run out of uranium. This, the current reality, is consistent with the low nuclear growth scenario

*/ Three of these five sentences (at pages 2, 19, and 43) summarize statements in the other two.

**/ If this approach were applied to all energy R&D activities it would make orderly program planning and this ERAB exercise meaningless.

of the most recent energy projection of the DOE Energy Information Agency's (EIA). It assumes no nuclear plants will be constructed beyond those where construction is already 10 percent complete. While this will probably be the most accurate of the EIA projections,*/ the following table shows that the minority estimate of nuclear plants built by 2020 (committed by 2010) is almost 2.5 times the EIA intermediate growth scenario and more than twice the nuclear capacity in EIA's highest nuclear scenario.

YEAR	DOE-EIA INTERMEDIATE-CASE GWE	DOE-EIA HIGH-CASE GWE	ERAB MINORITY GWE
1981	60	60	60
2000	175	195	200
2020	290	350	713

With its very high nuclear growth after 1990, the minority then argues that we will have committed 4.6 million tons of uranium by 2010 -- exceeding the domestic resources at a forward cost of $100/lb. The minority has conveniently ignored a) any reduction in LWR uranium requirements through increased fuel-use efficiency and reduced enrichments tails with advanced technology (30% to 50% improvements have been projected);**/ b) any improvements in uranium mining technology over the next 30 to 60 years; c) the more robust world uranium resource pictures;***/ and d) the availability of higher cost (lower grade) resources, domestic and foreign.

To further exacerbate the uranium supply picture, the minority implies that utilities will not build a nuclear plant in 2010 unless the uranium for all plants operating in 2020 is assured through 2050. This conveniently ignores the world experience with breeders that will be

*/ It should be noted that DOE and its predecessor agencies have consistently overestimated total energy, total electric, and nuclear electric energy growth during the past eight years.

**/ DOE, NASAP Report, DOE/NE-0001, Executive Summary, June 1980, p. 11.

***/ Two of our closest allies, Canada and Australia, are major export countries. In part because of competition from cheaper, higher grade foreign uranium resources, the domestic uranium producers are currently seeking protective import restrictions.

accumulated between now and 2010 that will permit prudent decision making regarding the need for and timing of commercial breeder introduction.*/

Properly framed, the uranium supply argument is subsumed in the larger question of when the breeder will become economically competitive with the LWR. The minority claims "most US groups estimate the uranium break-even price at about $50-$150/lb (1980 dollars." This claim is incorrect. The range in the most recent analyses is $150/lb to $400/lb.**/ With more credible assumptions regarding the growth rate in nuclear capacity and the capital cost difference between LMFBRs and LWRs, the breeder is unlikely to be economically competitive with conventional reactors until well into the next century, if ever.

More important than the issue of whether the breeder will ever be economical is whether the US can afford to wait a decade before reassessing whether to commit to a demonstration plant. The current economic outlook of the breeder strongly favors delay.***/

SUNK COSTS VS. FORWARD COSTS

The minority argues that cancellation of CRBR will result in the loss of over $1 billion investment already incurred. This is a familiar argument, but one based on bad economic theory. One should weigh forward benefits against forward costs and not sunk cost to evaluate the wisdom of proceeding.****/ Current estimates of the total project cost are in

*/ The French will have operated the commercial size Super Phenix breeder reactor for some 25 years by 2010. Also, the US breeder program, even without the CRBR, would be one of, if not the, largest energy R&D efforts in the world.

**/ DOE, NASAP Report, DOE/NE-0001/5, June 1980, p. 42 gives $120 to $200/lb as the indifference price for LMFBR costing 1.25-1.5 times LWR as compared with a 15% improved LWR. Brian G. Chow, "Economic Comparison of Breeders and Light Water Reactors, Pan Heuristics, 23 July 1979, p. 74, projects $150 to $438/lb.

***/ In 1990, we will be in a far better position to judge the economic outlook for breeders based in part on the additional French experience. We will know also whether the "second coming" of nuclear power in the US is real or imaginary.

****/ The minority also takes no credit for R&D benefits obtained from $1.03 billion sunk of which only $608 million represents hardware completed or on order. Furthermore, if the project were cancelled part of $353 million (for hardware on order) would be recoverable.

the range of $3.2 billion (1981 dollars) making the forward cost in excess of $2 billion,*/ an amount well worth saving, or applying to other more cost effective energy R&D programs. Furthermore, the $2 billion forward cost estimate is unrealistically low.**

DEMONSTRATION OF SAFETY AND LICENSING

The minority claims that "even if one accepts the argument that the breeder reactor would only provide a useful option in the future it is still necessary to complete the Clinch River Project in order to actually demonstrate this technology in the US licensing and safety environment."***/ Safety and licensing requirements, however, are evolving and would likely change drastically by the time the breeder is commercialized.****/ There is little to be gained by demonstrating present breeder technology in the current licensing and safety environment. Even if one accepted the minority view that one might wish to deploy breeders in 2010, it would make far more sense to demonstrate licensing in 2000, some 20 years hence.

*/ The latest total CRBR project cost estimate is $2.88 billion (1980 dollars), based on 8% escalation rate and a completion date of 1988. By way of comparison the entire project was estimated in 1973 to cost $700 million.

**/ It is based on a) the unlikely prospect that DOE will obtain approval from NRC to begin site work prior to completion of safety and environmental reviews, b) estimates of the construction schedule and cost that do not reflect the experience of most nuclear projects of this type, and c) the assumption that the Clinch River site is suitable. With regard to the last, NRC may require an alternate site, in part because of unfavorable meteorology and post TMI limits on population density. In this event the project would be set back an additional 4 years at an added cost of $1.7 billion.

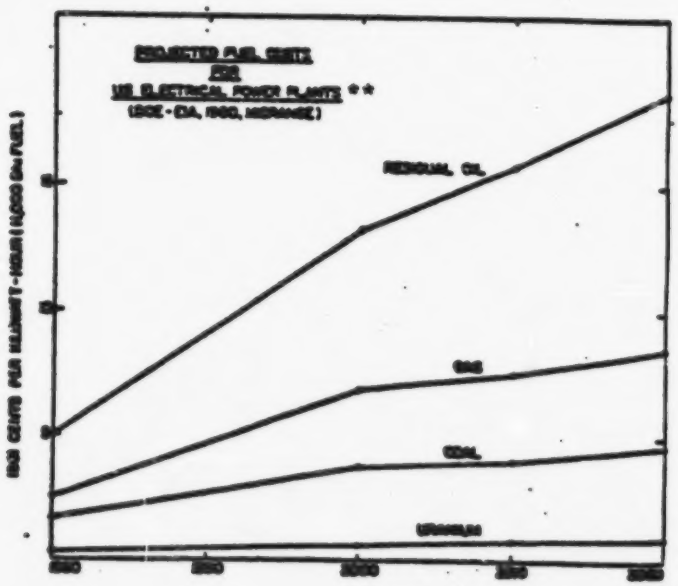
***/ This argument would have been a bit more persuasive were it not for the fact that DOE has just requested a licensing exemption for the NRC (Letter from DOE Secretary Edwards to Nunzio Pallidino, Chairman NRC, Nov. 30, 1981) in order to commence early site preparation work prior to completion of the required safety and environmental reviews and hearings. This request, if granted, would enable DOE to initiate site work prior to the next CRBR budget review by the Congress.

****/ Anyone who seriously questions this need only examine the effect the TMI accident has had on the licensing requirements in effect just two years ago.

APPENDIX D

CONCLUDING REMARKS

The ERAB report raises the question of whether "federally-sponsored nuclear programs are receiving a larger portion of funding completely out of line with the expected nuclear share of the US energy mix during the next few decades." In the President's FY 1982 energy R&D budget $875.6 million -- some 31% of all R&D funds exclusive of the Science and Technology Base (see Table III-D) -- is devoted to breeders and advanced uranium enrichment technologies.*/ These activities can be seen, as viewed from the market place, as attempts to reduce the impact of rising uranium prices. The figure b e l o w suggests that the problem is not with the uranium but with oil. When one also realizes that a) we can safely defer a commitment to the CRBR, b) the LMFBR base program expenditures can be substantially reduced once the program is refocussed for the longer term, c) a 50% reduction in the price of uranium enrichment will reduce electricity prices by only 0.1¢/kwh, d) our national security problem is with oil, not uranium, and e) improvements in energy productivity have proven to be the more cost effective means of providing additional "supplies," there can be little doubt that DOE energy R&D priorities are misplaced.



*/ $875.6 million represents the sum of the budgets for the LMFBR Base, CRBR, Breeder Fuel Cycle R&D, Uranium Enrichment R&D (Centrifuge and AIS), and the LWBR (See Table IV-A, pp. 20).

**/Frank von Hippel, Testimony before the Subcommittee on Energy Conservation and Power, of the House Committee on Energy and Commerce, October 5, 1981.

APPENDIX D

DISSENT TO THE RECOMMENDATION WITH RESPECT TO ELECTRIC AND HYBRID VEHICLES

Electric and hybrid vehicle technology is high risk, but promising, and its continued development would well serve the long term national interest. The technology is high risk because the economic viability of electric and hybrid vehicles has not been demonstrated. It is promising because of the rapid advances in the offing for performance improvements and cost reductions of electric drive systems based on power semiconductor devices, and because of continued progress in battery technology. And, it would serve the long term national interest because it directly addresses the problem of total dependence of the US on liquid fuels for personal transportation services.

Under normal circumstances it would be expected that development of electric vehicle technology would be pursued at a reasonable level by the automobile industry. However the present condition of the industry is such that it cannot be expected to pursue this high risk development without some Federal support. Termination or sharp reduction of the Federal program at the present time would significantly delay electric vehicle development and substantially increase the risk that this technical option would not be ready at the time when it might be needed.

Respectfully submitted: Roland W. Schmitt

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Washington, D.C. 20585

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Mr. DAVIS. Thank you very much, Mr. Chairman, and I am quite convinced we have not heard the last of the subject either.

Mr. FUQUA. You are absolutely correct.

Thank you very much.

The meeting of the joint committees will adjourn.

[Whereupon, at 12:25 p.m. the subcommittees adjourned.]

APPENDIX I

QUESTIONS AND ANSWERS SUBMITTED FOR THE RECORD

QUESTIONS SUBMITTED TO MR. RODDIS

FOSSIL ENERGY

1. Surface Coal Gasification. Your report alludes to a broad pilot and demonstration program outside DOE and notes that much of this effort is abroad. Regarding activities abroad, what contractual or licensing arrangements exist that will benefit our technology development if we forego such work ourselves?

Answer: Our recommendation on surface coal gasification was, as we indicated, based on the fact that a substantial number of projects in this area are already underway. These include such activities as the American Natural Resources Plant and the Cool Water Combined Cycle Facility. Projects underway abroad include such efforts as the Sasol-II plant in South Africa being built by the Fluor Corporation and the Exxon Catalytic Gasification Project in Holland. With respect to technology being developed and demonstrated abroad, the Board did not look at the specifics of contractual or licensing arrangements. However, I would expect that such arrangements can be worked out on a case by case basis as has been normal commercial practice in the past. A recent article in Science, Volume 215, Number 4540, 26 March 1982, summarized various other projects. Table 2 from that article follows.

Table 2. Status of second-generation coal gasification technologies (capacity greater than 100 tons per day).

Technology	Type	Plant capacity (ton/day)	Plant location	Product	Status
Texaco	Entrained	165	Oberhausen, West Germany	Gaseous fuel, synthesis gas	Operational
	Entrained	150	Muscle Shoals, Alabama	Synthesis gas, fertilizer	Start-up
	Entrained	150	Plaquemine, Louisiana	Gaseous fuel, electricity	Operational
Shell	Entrained	150	Harburg, West Germany	Gaseous fuel, synthesis gas	Operational
Combustion Engineering	Entrained	120	Windsor, Connecticut	Gaseous fuel	Operational
British Gas/Lurgi	Moving bed-slagging	350	Westfield, Scotland	Gaseous fuel	Operational
British Gas/Lurgi	Moving bed-slagging	700–800	Westfield, Scotland	Gaseous fuel	Construction, operation 1982
KiloCoa	Rotating kiln	600	Wood River, Illinois	Gaseous fuel	Construction, operation 1982
Lurgi	Moving bed (high pressure)	175	Dorsten, West Germany	SNG, fuel gas	Operational
Saarberg-Otto	Entrained-slag bath	250	Velbingen, West Germany	SNG, fuel gas	Operational

FOSSIL ENERGY

2. Coal Liquefaction. Your report cited the potential support from the Synthetic Fuels Corporation as one reason to justify DOE phasing out pilot plant and demonstration hydrogenation projects. What recommendation would you make if the SFC chose not to support any direct liquefaction projects on technical grounds? Would this not indicate that further large scale developmental work needed to be done to further mature or strengthen the technology?

In the face of supply and price uncertainty in the oil market, what leads you to believe that adequate private sector effort will ensue to improve the indirect liquefaction process?

Answer: The Board did not examine the prospect that the SFC might choose not to support any direct liquefaction projects on technical grounds, so it is difficult to speculate what view we might have if in fact no such projects are supported. The SFC was created by the Congress specifically to provide a vehicle through which the Government could share the risk with the private sector during the transition of synthetic fuels technology into normal commercial practice. Several direct liquefaction technologies have been demonstrated at various different scales with Federal support. Whether any of these look promising at this time for commercial scale up is precisely the kind of question that the private sector is better equipped to answer than is the Government. Such processes are being proposed now to the Synthetic Fuels Corporation. As indicated on page 26 of the Report the Board supports continued DOE smaller scale and technology base efforts in this area.

Whether adequate private sector effort will be undertaken to improve the indirect process is a question that is best answered through the business judgement of the companies that possess the appropriate expertise. For example, the Sasol and the Mobil technology might look attractive under some circumstances and in some locations, and not in others. Companies having a proprietary position in these markets have an obvious incentive to improve their processes as an investment for the long term regardless of the short term fluctuations in the liquid fuels market.

FOSSIL ENERGY

3. Heat Engines. Your report recommends effort directed at higher efficiency/higher temperature gas turbines. If this activity is terminated as proposed, what ramifications do you foresee in the international market noting the extensive Japanese effort in this area?

Answer: As you have noted, ERAB recommended continuation of the heat engine R&D program. It is hard to predict what the international ramifications might be of termination of the Government-funded effort. Substantial progress is, in fact, being made in this area and the private sector is investing in the turbine system for the Southern California Edison Cool Water Generating Plant. Several U.S. firms have significant programs in this area and should be able to compete for business in the international marketplace.

FOSSIL ENERGY

4. Magnetohydrodynamics (MHD). The Board foresees little commercial demand for this technology. Is this foresight based on the current market or projected 10 or 20 years in the future?

How would you characterize the technical problems that need to be overcome to develop MHD technology compared with those inherent in magnetic fusion?

Answer: The Board's assessment of the potential of MHD was based primarily on the remaining technical obstacles to be overcome and on the other advanced electric generation systems that will be available significantly earlier than MHD would be likely to be. These other approaches offer comparable high efficiency of energy conversion from coal to electricity with less overall technical risk and at an earlier date.

As to comparing MHD with magnetic fusion, such a direct comparison is fundamentally invalid. As mentioned before, there are many other ways to get electricity from coal. Fusion depends upon a fundamentally different process, the scientific feasibility of which has yet to be demonstrated but which nevertheless has enormous potential if the program of science and technology development is successful. This potential includes a new and vast fuel source and a variety of possible applications in addition to electricity.

FOSSIL ENERGY

5. Coal Conversion. In both coal liquefaction and gasification programs, ERAB recommended that funding could be reduced below the President's FY 1983 budget request. In your opinion, what constitutes a reasonable reduction, 10%, 20%, 50%? In the case of deep reductions, what should be the priorities--gasification, direct liquefaction, indirect liquefaction?

Answer: The Board deliberately did not specify a percentage change that would correspond to its recommendations for "more" or "less" funding, recognizing that specifying budget figures is the proper province of program managers and of the responsible Congressional Committees. Generally, the Board members are aware of the principle that in the support of R&D programs very abrupt changes in funding level can be wasteful and are generally inefficient. My own interpretation is that "less" would correspond to a 20 to 30 percent reduction. The Board used the President's FY 1982 budget as a base line and did not contemplate major reductions from those levels.

CONSERVATION AND RENEWABLE ENERGY

1. General. On p. 29 of the ERAB report it is stated that "relative to their potential contributions to the solution of the near- and medium-term energy problems there is an imbalance of R&D funds between the conservation programs and those directed at supply." What exactly is meant by that? What would be a more proper balance in your view?

Answer: As the report indicated, the Board is of the view that certain conservation programs should have either the same or increased funding. This simply reflects a general view that the private sector is unlikely to be able to make investments in some areas where more effort is needed to properly serve the national interest.

2. General. Do you think it was a wise decision to cut the conversation R&D budget from $311.5M to $126.7M in the President's FY'82 request and $17.5M in FY'83?

Answer: The Board considered the conservation R&D budget in the context of the President's FY 1982 request and came to the general conclusion that most of these programs should either be held level or increased. Although the FY 1983 levels were not specifically considered by the Board, obviously the tendency would be in the direction of restoring something like the FY 1981 levels.

CONSERVATION AND RENEWABLE ENERGY

3. Buildings and Community Systems. It is stated, also on p. 29, relative to Buildings and Community Systems, that "private sector R&D in this area is rare because of the undercapitalized nature of the industries involved." Could you explain this statement? Does it mean, in your view, that industry will be unable to pick up the research and development activities in the buildings sector if the Federal Government terminates its programs?

Answer: In the Buildings area, there is an overall problem of fragmentation and under capitalization that makes it difficult for the industry to invest in R&D. At present, the housing industry is severely depressed and the market for homes has always been subject to wide fluctuations. Nevertheless, national private sector organizations, with some Federal support, have been paying significantly increased attention to energy efficiency. The Board, at the Department's request, has established a Conservation R&D Panel to look more deeply at such questions. Among other things, the Panel is exploring whether a special R&D organization, with a role analogous to that of EPRI in the electric utility industry, would be feasible.

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4. Buildings and Community Systems. The report states that Buildings and Community Systems deserves increased funding relative to the President's 1982 request of $28 million. How much more--approximately? Double? Ten precent more? Ten times as much?

Answer: The Board did not specify in detail the extent of increased funding relative to the President's 1982 request. The specific funding level and distribution within that level should be based upon a well-conceived program plan with appropriate Congressional review. ERAB is not equipped to make such budget reviews in detail.

CONSERVATION & RENEWABLE ENERGY

5. Industrial Energy Conservation. The report states on p. 32 that ERAB recommends that the industrial conservation program be "restored to close to FY'81 funding levels" ($67M). Why? What makes the ERAB panel believe that "short-term, high-payoff R&D will not be conducted unless federal leadership is given?"

Answer: The Board's recommendation on industrial energy conservation is based in part upon the great disparity between different types of industries, and even between different firms within the same industry. This makes it difficult to generalize about the extent to which firms will invest in efficiency-related R&D and will install equipment to capitalize on this research. Some firms in some industries have moved rapidly to make such investments and perform such research, where they had high leverage situations and access to capital. The present very high cost of money wreaks havoc with investment efforts to replace energy intensive facilities in many instances. For many firms, research that might lead to a major change in their way of doing business is decidedly "long term" and not "short term." I believe that the Board's general impression is that the DOE program in this area is sound, gives careful attention to quantified potential pay off and to establishing a clear Federal role on a project for project basis. The program's cost sharing requirements provide an additional screening mechanism.

CONSERVATION AND RENEWABLE ENERGY

6. Industrial Energy Conservation. If the ERAB panel saw an FY'83 budget for DOE with no funds requested for Buildings and Community Systems, no funds for Industrial Energy Conservation, no funds for Transportation Energy Conservation, no funds for passive solar, do you think the panel would characterize that budget as consistent with its R&D priorities report? Would the panel characterize it as consistent with the national interest in energy R&D. Would you, personally, so characterize it?

Answer: It is difficult to speculate on what view the Board might have of the FY 1983 budget, since it did not address that budget in detail. Clearly, in some areas the FY 1983 budget goes in a different direction than the Board's recommendations, which were largely formulated last September. The extent to which changed economic conditions, including fuel prices, might change those views is quite uncertain. In addition, the Conservation Panel that I mentioned previously will be looking more intensively at these programs in the light of present budgets and institutional arrangements and mechanisms for encouraging conservation.

CONSERVATION AND RENEWABLE ENERGY

7. Transportation Energy Conservation. Please explain the report's recommendations on p. 31 that "the vehicle propulsion technology development program should be transferred to industry in an orderly way" and "electric and hybrid vehicle R&D should be sharply reduced."

Answer: It was generally felt that the development of advanced engines for automobiles should properly be the responsibility of the private sector. Substantial progress has been made in this country on improving the present spark ignition engine and on developing more efficient stratified charge and diesel engines. The priority to be given more advanced engines such as Stirling and turbines is best addressed by the automotive industry, which is, in any event, presently carrying the DOE program out. The proposed reduction in work on electric and hybrid vehicles was based on the concern that large scale demonstrations of these systems are premature. Major improvements in battery performance will be needed before these vehicles are likely to be practical. Several concerns are carrying out research on advanced batteries. ERAB did support continuing and strengthening the Energy Storage Program, in part with vehicle applications in mind. It should be noted that this recommendation is one of the two where a dissenting opinion was rendered (Appendix D of the Report).

CONSERVATION AND RENEWABLE ENERGY

8. Passive Solar. The report states on p. 33 that "continued federal support for basic and applied research in passive solar technology will pay high dividends. The building industry is fragmented and has no institutions capable of supporting this R&D activity." Could you elaborate on that statement? Does it mean that the DOE passive solar program deserves continued support in FY'83?

Answer: The problems mentioned with respect to passive solar are precisely the same as the problems addressed in describing the building and community systems program, i.e. that the building industry is not organized to carry on R&D effectively. There still remains a lot of room for improvement in building design. For residences, and other small structures, achieving good building energy design will be a drawn out process. The Board has recently established a Solar Energy Panel that will address such questions in more detail.

9. Biomass. On p. 27 the report states that biomass R&D is given "high priority with respect to technical potential" but "medium priority with respect to all other criteria." Could you explain that? Is it the ERAB panel's view that biomass and alcohol fuels R&D should continue at roughly FY 1983 funding levels?

Answer: As noted before, the Board did not address the FY 1983 funding levels. The "technical potential" rests on the prospect that of the many cellulosic conversion processes now being investigated one or more may prove economic, making available a much increased resource base. The Board's recommendations generally indicated that Biomass and Alcohol Fuels should have roughly the same funding as proposed in the President's FY 1982 budget.

CONSERVATION AND RENEWABLE ENERGY

10. Geothermal. The ERAB report recommends de-emphasis of the geothermal electric area where, it says, industry is capable of solving the remaining problems.

In testimony before our Energy Development and Applications Subcommittee last year, the Heber Project Manager from Pacific Gas and Electric stated that the project would be terminated without continued federal support; in this case a cooperative agreement wherein the government contribution is returned upon successful commercial operation.

If projects such as Heber are terminated, how will industry solve, or even identify, the remaining problems of commercializing this technology?

Answer: In the case of geothermal demonstration projects, the Board clearly felt that the basic technical questions involved with hydrothermal systems have been sufficiently addressed and that the issues involved with the development of commercial scale geothermal plants are primarily economic. For example, there are now quite a number of years of operational experience available from the Mexican facilities at Cerro Prieto and previous Federal funding of other projects has explored most of the technical issues. It is quite conceivable that geothermal projects will not be undertaken because the economics are not promising. Such judgments are best left to the private sector.

CONSERVATION AND RENEWABLE ENERGY

11. Inventors Program. The ERAB study concludes that the Inventions program deserves relatively less emphasis since money devoted to it could be more productively used in the Energy Conversion and Utilization (ECUT) program, particulary if ECUT is restructured along the lines ERAB recommends. Yet a study by the MIT Innovations Center of Inventions funded by DOE in FY 1979 concluded that a four-project sample would yield an estimated energy savings of 35.4 million bbl oil/year equivalent, which at that time equalled a societal return of $46,100 for each federal dollar expended. With this magnitude of return, what rationale was used in justifying a de-emphasis of the inventions program?

Answer: The view expressed concerning the Inventions Program derives from the fact that development of inventions is primarily appropriate for private venture capital investment and, now that increased energy prices have been largely internalized by the economy, such investors are better suited to judge the potential of investment than is the Federal Government. It is a fact that the Inventions Program has screened thousands of proposals in order to support a modest number of successful projects.

CONSERVATION AND RENEWABLE ENERGY

12. Electric Energy Systems. Regarding Electric Energy Systems, the Board stated on p. 22, "R&D on electricity transmission and distribution is regarded as essentially the responsibility of private industry.

a) How did the Board conclude that?

b) What quantitative data does the Board have to substantiate who in private industry will support what and at what funding levels?

c) Did the Board draft a model plan for its own reference or publication based on this quantitative data which illustrates how each area of transmission and distribution will not only be adequately pursued and by whom, but how it will be integrated in a timely manner?

d) Very basically, assuming a d.c. transmission system is a desirable research task and that private industry were to undertake research in various subsystems and components, then who would manage the conduct of the task to assure that the fragments were all integrated at least to the same voltage, much less resolve the much finer interfaces?

e) Would EPRI pick up this responsibility for all Electric Systems research?

f) Did EPRI agree to this?

g) If so, what level of funding have they confirmed in the areas previously pursued by DOE?

h) Who in private industry has committed to what bits and pieces? Specifically, what subsystems and components have not been committed to?

i) What is the Board's position on gas insulated direct burial cable, or HVDC transmission, on 1200 KV transmission (a.c.), on grid interconnections, high voltage health effects, systems architecture—especially control and enhanced communications, and the BEST facility in New Jersey?

Answer:

a) The conclusions of the Board with respect to electric transmission and distribution arise from the simple fact that transmission and distribution are fully commercial activities of the electric utilities industry, which has established a research entity, Electric Power Research Institute, that is fully capable of sponsoring research in

those areas and setting priorities. EPRI has a fine research and technology advisory committee structure and is well equipped to identify research priorities most appropriate to the needs of the industry. The size of the effort supported by EPRI is limited by competition for EPRI funds and by the fact, as noted in our report, that Government utility organizations such as Western Area Administration do not contribute to EPRI the way the vast majority of the electric utilities do. The electric energy systems program was initiated in part as an indirect mechanism for providing such contributions. It would be better for Government utilities to participate in EPRI directly rather than to continue a parallel Government-funded and prioritized effort.

b) The Board did not examine this question in quantitative terms. We did note that regulated industries have trouble raising R&D funds through the rate setting mechanism. Generally, the ERAB report reflects the concept that the funding of R&D in this area is principally the business of private industry.

c) The Board did not develop a detailed plan in support of specific areas of R&D in electric transmission and distribution. The Board is designated to give broad general advice, not to produce detailed program plans. EPRI is fully competent to carry out that effort.

d) The problems of system integration and interface among electric utilities are appropriate areas for consideration by EPRI and other industry organizations and the Board did not examine such questions in detail. This is an area that the private sector is quite competent to

handle and there are several research firms that provide assistance to utilities and groups of utilities in system planning, control, and integration.

e) Such a role for EPRI seems generally appropriate, except in a few areas such as the environmental effects of high voltage transmission, where Government sponsorship might be desirable to enhance credibility. Between EPRI, the supplier companies and individual utilities, there is sufficient capability to execute this overall R&D program.

f) The Board did not carry out detailed discussion with EPRI. The responsibility for appropriate transfer or termination of co-funded projects is a management issue for the Department.

g) The Board did not examine EPRI future funding plans.

h) The Board did not examine on a detailed project by project basis which elements of the program might or might not be undertaken by private firms. This program is only one of 49 areas that the Board attempted to address from a board policy perspective.

i) The Board did not explore the specifics of these projects although they were briefed on the program and generally informed. Establishing priorities at that level of detail above is an appropriate task for EPRI and DOE program management.

SCIENCE AND TECHNOLOGY BASE
(ENERGY SUPPORTING RESEARCH AND GENERAL SCIENCE PROGRAMS)

1. Allocation of Research Funds. Is ERAB concerned about the distribution of funds and access to major facilities among energy researchers from the national laboratories, the university community and industry?

Answer: Yes, the Board recognized and is concerned about the increased cost of facility operations and the extent to which those costs eat into basic research funds that would otherwise support research. In addition, there is a general concern that further effort is needed in making such faciliites widely available. The Department is making significant progress in this area with its new facilities such as the National Synchrotron Light Source at Brookhaven National Laboratory and the Combustion Research Facility at Sandia. The national laboratories must be considered to be important national resources and it is vital that any qualified potential users of these facilities have appropriate access to them. The Board is presently undertaking a major study of the future of the multiprogram national laboratories and will be exploring many of these issues in much greater detail.

NUCLEAR ENERGY

1. High Temperature Gas Reactor (HTGR). On page 19 of the report, it is stated that "high temperature gas reactor funding has a lower priority" than other conventional reactor systems R&D programs.

a) What was the basis for this recommendation?

b) Did the Board consider the specific advantages or disadvantages of the HTGR, or was this recommendation based on the current dismal LWR market outlook?

Answer:

a) This recommendation was based on the fact that previous industrial orders for the HTGR had been bought out by the supplier and the industrial base seemed no longer to be in existence to provide for the construction of these reactor systems. Given the financial condition of the utilities industry and the difficulties already being experienced in adding LWR capacity the further commercialization of the HTGR seems unlikely. In any event the HTGR has already been demonstrated at commercial scale at the Fort St. Vrain plant in Colorado. Sufficient information seems available to allow utilities to make their own decisions concerning the purchase of this reactor system and further Federal support does not seem necessary.

b) Indeed the dismal present outlook for the LWR market was a major influence in our concern about the HTGR. The benefits of HTGR are known. In many respects it is an advantageous system from the standpoint of additional applications and inherent safety characteristics. It is still far from being as proven a quantity as the LWR. The choice between these systems is properly the business of the electric utilities.

c) The Board did not discuss in detail the future of the HTGR option if Federal support is withdrawn. There is sufficient concern about the possibility of losing the LWR option also which partly motivated our recommendation for increased funding in support of conventional reactor systems, particularly for efficiency improvements including high burn-up long life fuels.

ASSUMPTIONS AND METHODOLOGY

1. How does the ERAB feel about Federal support of development work? Specifically, where does research begin and where does it end? Can it be said that research ends with small-scale laboratory experiments and conceptual drawings, or is it necessary, in the Board's opinion, that work continue with development at a sufficiently large scale to prove the practicality of the concept?

Answer: ERAB felt it necessary to begin its deliberations by accepting the basic conceptual position of the Administration as regards R&D, i.e., that demonstration and commercialization are primarily private sector responsibilities and that longer term research is primarily a public sector responsibility. It is easy to get caught in semantic traps by oversimplifying these distinctions. The variations among industries and among technologies are so great that no "cook book" application of these principles makes sense. Proving the "practicality" of a concept is a complex process. Such proof, in a substantial measure, is in the eyes of the beholder. Whether something is practical depends significantly upon what party is taking what risks. The general notion of limiting Federal support of technology development to smaller scale systems and generic technologies seems to make sense, but this should be considered on a technology-by-technology basis.

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ASSUMPTIONS AND METHODOLOGY

2. On page 10 of your testimony, you state that "ERAB is also concerned that some energy R&D of great potential significance for the achievement of the Nation's energy goals will fall between Federal and industry responsibilities." What R&D do you think is encompassed in this "gray" area?

Answer: It was the Board's view that the overall policy perspective of the Administration was an appropriate starting point for the study but there are some instances in which Government regulations result in weakened incentives to spend on R&D. There are other areas, such as the building industry, where the private sector is fragmented and has not had the capability to carry out an effective R&D program. In addition, there are areas such as environmental health and safety where a continued Federal role is necessary both to provide an appropriate level of funding and to provide credibility.

3. On page 10 of your testimony, you note that "there are other circumstances in which it would be unrealistic to expect timely and effective assumption by industry of R&D responsibilities abdicated by the Government, however worthy the projects involved, and despite the provisions of new generous tax incentives." What R&D projects do you have in mind here?

Answer: As mentioned in my reply to question 2, regulated and fragmented industries tend to underinvest in R&D, and the impact of the tax credit for incremental R&D investments is difficult to evaluate at this time. During this transition period, it is necessary to maintain a degree of flexibility that will insure that proper investments of public funds lead to appropriate transfers to private responsibility. The actual implementation of this concept at the level of R&D projects is a matter for the Department and not for the Board.

ASSUMPTIONS AND METHODOLOGY

4. On page 10 of your testimony, you note that ERAB does not question the Administration's shift toward research with longer range impacts as a general proposition as long as it recognizes valid exceptions. What do you consider exceptions?

Answer: Among the valid exceptions are those areas in which the private sector, for various reasons beyond its control, lacks the resources or incentive to undertake the needed R&D. This would include such areas as breeder and conventional reactors due to their high inherent present cost and intrinsic long-range payoff. This would also include areas of Federal responsibility, due to a regulation or oversight role, such as environmental protection and nuclear waste.

5. On page 11 of your testimony, you note that ERAB's evaluations took the Administration's policies and guidelines relative to the Federal role very seriously but that exceptions had been made. What were these exceptions?

Answer: Some of these exceptions were discussed in the response to the previous question. For instance, there are some industries, such as the building industry, that are fragmented and lack the capability at this time to mount an R&D program. In addition, there are some areas, such as advanced uranium enrichment techniques, where the government is the customer for the results of the research since uranium enrichment is presently carried out under government auspices.

ELECTRIC SUPPLY

1. In its report, the Energy Research Advisory Board recommends that, "Demonstration of breeder technology be delayed until a future time." This statement clearly implies the termination of the present CRBR project.

a) What economic criteria did the Board utilize in reaching this conclusion?

b) Did the Board take into account the fact that the total estimated costs for the project had significantly increased over the last few years?

c) What is the explanation for this increase?

d) Does the Board believe that these costs would increase even more if the project were to go forward?

e) What were the Board's opinions on the private share contributions to this project?

f) When did the Board estimate a breeder should be demonstrated?

g) Does the Board believe that there are more cost-effective means besides the breeder for providing additional energy supplies in the near future?

Answer:

a) The Board did not undertake an independent and detailed economic analysis in connection with CRBR but reacted to the perceived lack of urgency for a demonstration breeder due to a declining demand for nuclear facilities and the long-term nature of breeder reactor development. There was a dissenting view (see Appendix D of the Report) that was based upon the role of such a facility as a technical program component of intermediate scale that would provide a focal point for addressing and proving out various aspects of the technology.

b) The Board did not examine the cost of this project in detail but recognized that the project had a high cost and limited potential. Undoubtedly, some of the cost escalation is due to major shifts in Government policy toward this project in the previous Administration.

c) The Board did not address this question.

d) The Board did not examine alternate cost profiles for CRBR under differing assumptions and did not examine the detailed elements of the project.

e) The Board did not address this question except to note that it was not a major part of the total project cost.

f) The Board did not attempt to establish a feasible time at which an intermediate scale LMFBR should be demonstrated. The need for such a demonstration depends on the urgency--determining the time at which the breeder will be needed as an adjunct to light water reactor development due to fuel constraints. Such a demonstration will affect utility industry confidence in the long-term potential of fission systems and this Nation's position with respect to international competition in the nuclear energy business. The entire Board did support the overall program of LMFBR development.

g) By the structure of its report (See Table IV-A on page 20), it is evident that the Board choose to rank their priorities on those R&D programs that address electricity supply as a group. Since there are 16 such programs, it was necessary to make judgements of relative priorities among these and we did so. The Nation has abundant supplies of other fuels, particularly coal, in the near and intermediate term and has the prospect of the use of fusion or major scale solar energy conversion in the very long term. There are also alternatives to the LMFBR for producing fissile fuel, i.e., the fusion hybrid, the accelerator breeder and advanced isotope separation technologies. The Board did not, however, undertake a comparative cost benefit analysis among these approaches.

ELECTRIC SUPPLY

2. The Board is reported to foresee little commercial demand for MHD. A cited problem is the "extreme temperature/erosion" regime.

To what extent could this problem be defined, studied, and alleviated by basic research?

Answer: The Board indeed saw little commercial potential for MHD. MHD conversion must be carried out at large scale in order to provide the projected efficiency gain and involves several complex technologies. Other approaches toward increased efficiency of coal burning with an improved environmental performance will be available sooner. High temperatures are inherent to the MHD process, while the erosion problems are inherent in the use of pulverized coal as a fuel. The basic problems associated with operating in this regime have been quite extensively studied and led to some of the more demanding technical requirements for MHD systems.

ELECTRIC SUPPLY

3. A recent GAO report indicated that it was necessary to build a geothermal demonstration project if industry was to take over and commercialize relatively lower temperature geothermal resources. Based on this report, as well as previous testimony and information presented to the Committee, the Committee has authorized a cost-sharing binary demonstration project located in Heber, California.

a) What is the Board's position on demonstration projects generally?

b) Do you believe that we need a demonstration project if we are to commercialize the binary technology?

Answer:

a) The Board generally agrees with the Administration position that commercial scale demonstrations are primarily the responsibility of the private sector.

b) Certainly a demonstration project would increase the confidence of potential utility company investors in binary scale geothermal systems. The basic question here is economics. If a particular site and system look highly promising, then such a plant will undoubtedly be built. The private sector is perfectly capable, in my view, of making these decisions.

ELECTRIC SUPPLY

5. In previous years, the fusion program was planned on the assumption of an increased budget pie. It could therefore support the focused effort on the Center for Magnetic Fusion Engineering and eventually the Fusion Engineering Device, and at the same time continue a strong effort in a wide variety of alternative concepts. Now, the fusion program no longer sees a growing budget, and the ERAB report recommended a decrease in the budget and a stretching out of the program.

a) How do you recommend we resolve the conflict between a focus on the Tokamak concept and a diversified number of alternative concepts such as mirror design or the Elmo Bumpy Torus?

b) Since you also recommended an enhanced effort on a fusion-fission hybrid for the breeding of nuclear fuels, are you therefore recommending more emphasis on mirror concepts since they seem to be most suited for such an application?

Answer:

a) The fusion program is still at an early stage and in such a long term program you can always stretch out such activities. Since it is not possible at present to make a confident determination of the best configuration for a practical fusion reactor it is necessary to continue to explore the physics of a number of alternative concepts. The Department plans to do just this within the constraints of the budget. It would be quite unwise to select a particular reactor concept prematurely and focus on that one to the exclusion of others that might ultimately be more practical.

b) The Board did not take a position on the choice of configuration for a hybrid fusion-fission system. There are many approaches to fissile fuel breeding that are worth exploring.

FUEL SUPPLY

1. The report claims a "very extensive effort in the private sector" to develop improved indirect liquefaction. Who are these participants and for what period have they been active?

Answer: Among the projects underway in indirect liquefaction are Fluor work for Sasol based on modified Fischer-Tropsch processes and the Mobil-MTG process based on methanol. Most indirect processes involve an initial step of gasification so that the various gasification projects already underway contribute to improving the indirect liquefaction approach. We did not examine the projects in detail. Some advanced indirect liquefaction projects are presently being considered by the Synthetic Fuels Corporations. Much of the Sasol technology is based on work in Germany prior to and during World War II, while the Mobil process, which depends on a class of shape-selective catalysts, is more recent.

FUEL SUPPLY

2. The ERAB report found that R&D for electric supply technology is receiving a larger proportion of funding than the present and projected share of electricity in our national energy supply. Nevertheless, programs to develop liquid fuels such as the biomass program are being severely cut back. I understand that the ERAB Board issued a report last November on the biomass program which indicated that biomass was a very promising energy resource. Do you believe that biomass can play a significant role in meeting the nation's future liquid fuels needs, and if so, do you believe that your funding recommendations in biomass reflect this potential?

Answer: We do believe that biomass can play a useful role in supplying liquid fuels but do not anticipate that it can provide a major portion of the nation's fuel needs. Our biomass report explicitly noted both the potential of biomass and its limitations and our funding recommendation reflects that potential.

3. As you are aware, the Federal coal R&D program has undergone a transformation between the Carter and Reagan Administrations. How has this change affected the coal industry, and do you believe that the Reagan approach emphasizing long-range, high-risk activities is the most appropriate approach in this area?

Answer: We have not examined this aspect of the coal industry's plans in detail and it is too soon to say what the effect of the Administration's policy shift will be. In general, the Board started from the Administration's overall approach and recognizes that many firms in the fossil fuel industry possess the resources to proceed to develop the needed technology.

FUEL SUPPLY

4. The ERAB report criticized the emphasis of DOE programs on electricity generation, and particularly criticized nuclear programs for this. The High Temperature Gas Cooled Reactor (HTGR) is an excellent application of nuclear energy for something other than electricity generation. In fact, the FY 1982 authorization stressed the process heat generation value of the HTGR and its utility in water short regions.

a) What is the rationale of the ERAB report in recommending increased funding for the conventional reactor systems (focused on electrical generation) and recommending a low priority for the HTGR?

b) Was the application of HTGR as a fuel substitute, e.g., synfuels production, considered by ERAB?

Answer:

a) It is our understanding that industry is quite aware of the process heat and cogeneration potential of the HTGR and is quite capable of deciding whether to employ that technology.

b) We did not consider synfuels production using the HTGR in any detail but were aware of this as a possibility.

CONSERVATION AND UTILIZATION

1. One of the Energy Advisory Research Board's most significant recommendations is that conservation funding should be increased. This recommendation is based on the Board's belief that conservation should be one of the Department's highest energy R&D priorities.

a) Do you have any opinions on the best way to reorganize DOE in order to reflect this finding?

b) Do you believe that the proposed Administration DOE reorganization plan is the right approach?

Answer:

a) I prefer not to comment on the organizational structure of the DOE. The Board has not examined this matter.

b) The organizational format for DOE is a matter for the Administration and the Congress to work out.

CONSERVATION AND UTILIZATION

2. Last year, the Science and Technology Committee held hearings on the impacts of oil decontrol on our Nation's R&D programs. During these hearings, the Committee heard many comments on the appropriate role of the Federal Government in energy research and development.

a) What do you believe is the appropriate role for the Federal Government in energy R&D, especially in the conservation area?

b) What impacts do you believe oil, and possibly natural gas deregulation, will have in the conservation area?

Answer:

a) As indicated in our report, we accepted as a starting point the basic posture of the Administration that the principal focus of Government R&D funding should be in those long range and potentially high-payoff areas where there is little incentive for private sector investment. In addition, one must consider such factors as the extent of private sector capability in the particular area, possible environmental or safety considerations and national security implications. We tried to consider all these matters under the criteria used in the study. In the conservation area it was our view that in some of the buildings and industrial areas the likelihood of private industry continuing some needed programs was small due to fragmentation and limited available capital. We have established a Conservation Panel to further refine this perception of the Federal role.

b) It seems quite evident that oil price deregulation has been working. Ultimately gas price deregulation under the NGPA will stimulate conservation and solar investment. There is less progress presently with electricity rates. Price signals do work. However, price isn't everything. Some natural gas will still be very cheap due to long term contracts and there is an inherent inertia in the marketplace. Individuals do not necessarily make the least cost choice in their purchases nor undertake life cycle cost analysis. Thus there still will be a need for Federal leadership.

CONSERVATION AND UTILISATION

3. As you are well aware, there are currently many Federal tax incentives now on the books to stimulate conservation activities. These include both a residential and business conservation tax credit, as well as the new incentives included in the Economic Recovery Tax Act for capital investment and productivity.

a) What impacts do you believe that these tax credits will have in stimulating new construction investments?

b) Can these incentives take the place of on-budget Federal support in the conservation area?

Answer:

a) The Board has not examined the impact of tax credits in any detail. This would require an extensive economic analysis that neither I nor the Board has done. My guess is that the industrial and commerical sector will respond far more rapidly than will the residential sector.

b) These incentives do not replace the need for some Federal support of conservation-related R&D since they do not directly affect R&D. Also, not all individuals and organizations make their decisions on the basis of tax advantages.

CONSERVATION AND UTILIZATION

4. One of the most interesting recommendations in the ERAB report was the "R&D in the transportation sector should be redirected away from its present heavy emphasis on automobile engines and toward the heavy freight truck sector." We believe that this recommendation would call for a significant reorientation in the current DOE transportation program effort. As you may know, the Committee has in the past strongly supported legislation calling for the development of advanced automobile engines such as gas turbines and Stirling engines and advanced electric and hybrid vehicles.

a) Could you please explain why this program should be reoriented?

b) Do you believe that advanced automobile engines such as the gas turbine or Stirling could be worthwhile and useful?

Answer:

a) It is our view that the automotive industry has made considerable progress in developing more fuel efficient engines and is capable of continuing to explore the prospects for advanced engines such as the Stirling and gas turbine. Automotive companies have been the DOE's principal contractors in this area. The heavy freight truck industry, on the other hand, consists of a number of smaller firms not doing much R&D. This sector uses a lot of fuel and has been a neglected area.

b) Yes. The advanced engines do have considerable potential in the right place and time. The Government effort in this area has been quite successful in identifying the principal technical problems. The question is, whether a major Government push is needed now. In our view it is not.

CONSERVATION AND UTILIZATION

5. As you may know, the Science Committee has in the past strongly supported the industrial energy conservation program at DOE. This is consistent with the NRAB report recommendations. However, while supporting the program, a recent National Academy of Sciences study did find several problems with the industrial program, namely that selection procedures were weak, some questionable projects had been funded, there was a lack of communication between program personnel and industry, etc. Based on its review, the National Academy found that the, "Activity of the Office of Industrial Programs should be more focused on the support of long-range, high-risk R&D. . ."

a) Do you agree with this recommendation?

b) What else can be done to make the industrial program more useful?

c) Will the new Federal tax incentives provided in the Economic Recovery Tax Act of 1981 be useful in stimulating increased industrial conservation activities?

Answer:

a) Although I personally agree with the NAS recommendation, the Board did not examine the NAS report in detail.

b) The program should continue to apply its selection criteria rigorously. Generally, I believe the program has done a good job, has been selective, has identified appropriate areas for research, and has required cost-sharing to encourage technology transfer. Increased contact with industry would be desirable.

c) The impact of the tax incentives is hard to judge. Most companies are just assimilating these changes and will probably be wary of basing major investments on them until they see how permanent the incentives are. Our Conservation Panel is hearing testimony from several companies and may later express some view on this matter.

6. The Science and Technology Committee has generally supported the need for solar tax credits, and in particular, the 40% residential tax credit now on the books. Do you believe that this tax credit will be sufficient in future years to stimulate a viable solar industry?

ANSWER: I am not an expert in this area. NRAB has just established a Panel to look into the solar area more thoroughly, including the Federal R&D role. It, however, will not specifically address tax incentives since the Panel and NRAB itself are primarily expert in technical and business issues generally. Whether a viable solar industry emerges depends on whether companies develop products that meet a market need and are economic.

SCIENCE AND TECHNOLOGY BASE

1. Relative to climate and CO_2 research and the high priority assigned by the ERAB report, what period of research do you believe necessary to obtain indicative data? And to obtain definitive data?

Answer: The CO_2 and climate issue clearly requires a long-term effort. Data will need to be gathererd and evaluated that allows estimates of the extent of the problem to be made with confidence. The program is presently proceeding to fund research aimed at unraveling the CO_2 effect from natural changes in climate. Whether and when this research will prove "definitive" is somewhat in the eye of the beholder.

2. The ERAB's report refers to general environmental programs.

a) What recommendations can you provide on the responsible group or groups to perform the work, or whether the efforts should be consolidated?

b) What are the possible duration spans of these programs?

Answer:

a) The research effort should draw on the special talents of university, industry and national laboratory scientists. Consolidation of projects is a matter for program management to consider.

b) Environmental issues require continued refinement of knowledge. A long-term effort seems clearly justified.

SCIENCE AND TECHNOLOGY BASE

3. Within broad programs, what priorities were assigned to significant elements? For example, how did ERAB rate ISABELLE in High Energy Physics? How did it rate synfuels research in Health/Environmental Research?

ANSWER: The Board generally did not address the internal distribution of program budgets although in most cases we did comment on possible shifts in emphasis. We did not examine the details of High Energy Physics since the High Energy Physics Advisory Panel is assigned that task and is functioning effectively. The Board did address the need for continued research on the health and environmental aspects of synfuels just as with other energy systems.

CRBR

1. There is an increasing emphasis on industrial participation in energy development, and encouragement of technology transfer to industry. If the CRBR project were to be cancelled, would't this set up the worst sort of precedent for industry cooperation, as well as mean the loss of our best people from the program?

ANSWER: Major program changes at short intervals obviously create problems. The ERAB majority basically believed that CRBR was a project that time had passed by. The dissenters clearly felt that it was still needed as a central feature of the breeder technology effort.

2. The British are very enthusiastic about their breeder program. Walter Marshall, the Chairman of the United Kingdom Atomic Energy Authority, has stated that although their breeder will cost one and a half times the cost of a conventional reactor, it will still have a competitive advantage over alternative sources, such as oil-fired power plants. Can you clarify why the Europeans believe the breeder is both necessary and economic, and the ERAB report does not?

ANSWER: The situation in Europe is quite different from that in the U.S. where we have vast coal resources and substantial uranium resources. Thus the perceived need and urgency for the breeder is greater in other industrial nations than in the U.S.

1. What weights were attached to each of the ranking criteria and how were those weights determined?

Answer: The weights were determined by a voting process among all Panel members. They did not differ much, but the heaviest weight was placed on Federal role. Detailed supporting information is available in the Panel working papers.

2. The Technological Potential criterion used to evaluate energy programs gives the highest rating to those programs with the lowest technical risk.

a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

Answer:

a) This criterion was intended to describe technical readiness. Federal role was addressed through the Federal role criterion.

b) Since the Board did not consider the criteria separately, we cannot comment on this question.

3. The Economic Potential criterion used to evaluate energy programs gives the highest rating to those technologies that will be competitive with the existing technologies providing energy in the year 2000.

a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated.

Answer:

a) This criterion was not intended to address the Federal role.

b) Since the Board did not consider the criteria separately, we cannot comment on this question.

4. The Benefit/Cost criterion used to evaluate energy programs gives the highest rating to those technologies which require the least amount of R&D investment per quad of energy produced or saved in the year 2000.

a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

Answer:

a) This criterion was not intended to address the Federal role.

b) Since the Board did not consider the criteria separately, we cannot comment on this question.

5. The Energy Security criterion used to evaluate energy programs gives the highest rating to those technologies which will displace or substitute for 2.0 million barrels per day or more of oil equivalent by the year 2000.

a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

b) What numerical rating did the various electric technologies receive for this criterion?

c) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

Answer:

a) This criterion was not intended to address the Federal role. This was treated as a separate criterion.

b) Electric-related supply programs were numerically rated in terms of energy supply security as follows:

Conventional Reactors	2.07
Commerical Nuclear Waste	1.88
LMFBR Base Program	1.76
Magnetic Fusion	1.75
Defense Nuclear Waste	1.69
Uranium Resource Assessments	1.67
Breeder Fuel Cycle R&D	1.67
Clinch River Breeder Reactor	1.65
Centrifuge Enrichment	1.64
Solar Electric	1.63
Light Water Breeder	1.63
Advanced Isotope Separation	1.60
Geothermal	1.40
Electric Storage	1.37
MHD	1.20
Hydroelectric	1.20

c) Since the Board did not consider the criteria separately, we cannot comment on this question.

6. It appears that the definition of the Urgency criterion used to evaluate energy programs is ambiguous at best.

a) Would you please expand on the definition of the Urgency criterion?

b) Given this definition, which technologies would recieve high rankings and which technologies would recieve low rankings for this criterion?

c) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

Answer:

a) The Urgency criterion addressed the issue of how soon successful program results were needed. This is particularly relevant to liquid fuels technologies where some contribution to oil backout might be achievable and to other cases in which an early impact or a critical program milestone would be affected.

b) For example, very long term approaches such as magnetic fusion rated lower under this criterion than, say enhanced oil recovery.

c) Since the Board did not consider the criterion separately, I cannot comment on this question.

7. At least 4 of the 7 criteria used to evaluate energy programs appear to give the highest ratings to those technologies which are short-term and low-risk.

a) Given this fact, how can the Board have adequately assessed the need for Federal support of long-term, high-risk R&D?

b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

Answer:

a) The criteria were simply a screening device to identify those areas where consensus was high or low, and to provide a framework for discussion among diverse technical experts. The assessment of priority was not intended to indicate the need for a major Federal role. For example, we agreed that Enhanced Oil Recovery was of high priority for the Nation but had little need for Federal intervention. The overall policy of focusing Federal effort on long-term, high-risk, high-payoff R&D was taken as a basic starting point for our analysis.

b) ERAB consciously separated the issue of Federal role from overall National priority. Our discussions were explicitly based upon the stated policies of the Administration. Since the Board did not consider the criteria separately, we cannot comment on this question.

QUESTIONS FOR HEARING ON FEDERAL ENERGY R&D PRIORITIES

MARCH 5, 1982

FOSSIL ENERGY

Dr. Davis

1. Heat Engines. Why has the High Temperature Turbine Technology program been terminated when the ERAB report recommends continuation and the DOE Sunset Review recognizes the technical and environmental advantages of this technology?

2. Combustion Systems. In light of the ERAB report's recommendation for continued work on pressurized fluidized bed combustors related to cogeneration applications, what rationale justifies termination of DOE involvement at the Woodbridge and Grimethorpe projects; the former being a cogenerator and the latter incorporating that option in the future plans?

3. Magnetohydrodynamics (MHD). In recent testimony before two House Subcommittees Secretary Edwards expressed regret over the foreign exploitation of some technologies which the United States pioneered. By terminating the MHD program, do you not fear that our current leadership will be sacrificed to the Soviet Union among others?

4. Coal Combustion and Utilization. Given the structure of the coal production companies and the utilities, do you see any possibility that the private sector would be able to continue development of advanced combustion techniques or fuel cells if federal funding is withdrawn? What, in your view, will happen to the scientists and engineers presently working on these projects?

Mr. Roddis

1. Surface Coal Gasification. Your report alludes to a broad pilot and demonstration program outside DOE and notes that much of this effort is abroad. Regarding activities abroad, what contractual or licensing arrangements exist that will benefit our technology development if we forego such work ourselves?

2. Coal Liquefaction. Your report cited the potential support from the Synthetic Fuels Corporation as one reason to justify DOE phasing out pilot plant and demonstration hydrogenation projects. What recommendation would you make if the SFC chose not to support any direct liquefaction projects on technical grounds? Would this not indicate that further large scale developmental work needed to be done to further mature or strengthen the technology?

In the face of supply and price uncertainty in the oil market, what leads you to believe that adequate private sector effort will ensue to improve the indirect liquefaction process?

3. Heat Engines. Your report recommends effort directed at higher efficiency/higher temperature gas turbines. If this activity is terminated as proposed, what ramifications do you foresee in the international market noting the extensive Japanese effort in this area?

4. Magnetohydrodynamics (MHD). The Board foresees little commercial demand for this technology. Is this foresight based on the current market or projected 10 or 20 years in the future?

How would you characterize the technical problems that need to be overcome to develop MHD technology compared with those inherent in magnetic fusion?

5. Coal Conversion. In both coal liquefaction and gasification programs, ERAB recommended that funding could be reduced below the President's FY 1983 budget request. In your opinion, what constitutes a reasonable reduction, 10%, 20%, 50%? In the case of deep reductions, what should be the priorities - gasification, direct liquefaction, indirect liquefaction?

CONSERVATION AND RENEWABLE ENERGY

Mr. Roddis

1. General. On p. 29 of the ERAB report it is stated that "relative to their potential contributions to the solution of the near- and medium-term energy problems there is an imbalance of R&D funds between the conservation programs and those directed at supply." What exactly is meant by that? What would be a more proper balance in your view?

2. General. Do you think it was a wise decision to cut the conservation R&D budget from $311.5M in FY'81 to $126.7M in the President's FY'82 request and $77.5M in FY'83?

3. Buildings and Community Systems. It is stated, also on p. 29, relative to Buildings and Community Systems, that "private sector R&D in this area is rare because of the undercapitalized nature of the industries involved." Could you explain this statement? Does it mean, in your view, that industry will be unable to pick up the research and development activities in the buildings sector if the Federal Government terminates its programs?

4. Buildings and Community Systems. The report states that Buildings and Community Systems deserves increased funding relative to the President's 1982 request of $228 million. How much more - approximately? Double? Ten percent more? Ten times as much?

5. Industrial Energy Conservation. The report states on p. 32 that ERAB recommends that the industrial conservation program be "restored to close to FY'81 funding levels" ($67M). Why? What makes the ERAB panel believe that "short-term, high-payoff R&D will not be conducted unless federal leadership is given?"

6. Industrial Energy Conservation. If the ERAB panel saw an FY'83 budget for DOE with no funds requested for Buildings and Community Systems, no funds for Industrial Energy Conservation, no funds for Transportation Energy Conservation, no funds for passive solar, do you think the panel would characterize that budget as consistent with its R&D priorities report? Would the panel characterize it as consistent with the national interest in energy R&D? Would you, personally, so characterize it?

7. Transportation Energy Conservation. Please explain the report's recommendations on p. 31 that "the vehicle propulsion technology development program should be transferred to industry in an orderly way" and "electric and hybrid vehicle R&D should be sharply reduced."

8. Passive Solar. The report states on p. 33 that "continued federal support for basic and applied research in passive solar technology will pay high dividends. The building industry is fragmented and has no institutions capable of supporting this R&D activity." Could you elaborate on that statement? Does it mean that the DOE passive solar program deserves continued support in FY'83?

9. Biomass. On p. 27 the report states that biomass R&D is given "high priority with respect to technical potential" but "medium priority with respect to all other criteria." Could you explain that? Is it the ERAB panel's view that biomass and alcohol fuels R&D should continue at roughly FY 1983 funding levels?

10. Geothermal. The ERAB report recommends de-emphasis of the geothermal electric area where, it says, industry is capable of solving the remaining problems..

In testimony before our Energy Development and Applications Subcommittee last year, the Heber Project Manager from Pacific Gas and Electric stated that the project would be terminated without continued federal support; in this case a cooperative agreement wherein the government contribution is returned upon successful commercial operation.

If projects such as Heber are terminated, how will industry solve, or even identify, the remaining problems of commercializing this technology?

11. Inventors Program. The ERAB study concludes that the inventions program deserves relatively less emphasis since money devoted to it could be more productively used in the Energy Conversion and Utilization (ECUT) program, particularly if ECUT is restructured along the lines ERAB recommends. Yet a study by the MIT Innovations Center of inventions funded by DOE in FY 1979 concluded that a four-project sample would yield an estimated energy savings of 35.4 million bbl oil/year equivalent, which at that time equalled a societal return of $46,100 for each federal dollar expended. With this magnitude of return, what rationale was used in justifying a de-emphasis of the inventions program?

12. Electric Energy Systems. Regarding Electric Energy Systems, the Board stated on p. 22, "R&D on electricity transmission and distribution is regarded as essentially the responsibility of private industry."

a) How did the Board conclude that?

b) What quantitative data does the Board have to substantiate who in private industry will support what and at what funding levels?

c) Did the Board draft a model plan for its own reference or publication based on this quantitative data which illustrates how each area of transmission and distribution will not only be adequately pursued and by whom, but how it will be integrated in a timely manner?

d) Very basically, assuming a d.c. transmission system is a desirable research task and that private industry were to undertake research in various subsystems and components, then who would manage the conduct of the task to assure that the fragments were all integrated at least to the same voltage, much less resolve the much finer interfaces?

e) Would EPRI pick up this responsibility for all Electric Systems research?

f) Did EPRI agree to this?

g) If so, what level of funding have they confirmed in the areas previously pursued by DOE?

h) Who in private industry has committed to what bits and pieces? Specifically, what subsystems and components have not been committed to?

i) What is the Board's position on gas insulated direct burial cable, on HVDC transmission, on 1200 KV transmission (a.c.), on grid interconnections, high voltage health effects, systems architecture - especially control and enhanced communications, and the BEST facility in New Jersey?

Dr. Davis

1. General. Were the recommendations of the ERAB report incorporated into DOE's FY 1983 budget request? Did they have any impact on the levels of funding requested? Specifically, did they have any impact on the levels requested for industrial conservation, passive solar, buildings and community systems?

2. General. Do you agree with the statements on p. 45 of the ERAB report that "the overall level of federal R&D funding for conservation and improved utilization is too low" and "the balance between supply-oriented R&D conservation R&D is too heavily weighted toward the former?" If not, what evidence do you have to contradict this statement?

3. Buildings and Community Systems and Industry Energy Conservation. The ERAB report recommends increased funding for buildings and community systems and industrial energy conservation. Yet, it is our understanding that both of these programs are being terminated by DOE in FY 1983. How can you justify that termination in light of a strong contrary recommendation by your own panel of experts? Do you have any hard evidence to counter the justifications given by the ERAB panel for recommending increasing support for these programs, especially those relating to the inability of industry to perform the R&D on its own?

4. Transportation Energy Conservation. Please give your justification for terminating the DOE R&D programs in transportation conservation, passive solar and energy storage in light of the ERAB recommendations that they be continued at level funding.

SCIENCE AND TECHNOLOGY BASE
(ENERGY SUPPORTING RESEARCH AND GENERAL SCIENCE PROGRAMS)

Mr. Roddis

1. Allocation of Research Funds. Is ERAB concerned about the distribution of funds and access to major facilities among energy researchers from the national laboratories, the university community and industry?

Dr. Davis

1. Universities. University Research Support received a high priority, increased funding rating in the ERAB report. Why then was the University Research Support budget cut from $10 million in FY 1982 to about $5 million for FY 1983? In particular, why was the modest $1 million energy traineeship program for graduate students eliminated from the FY 1983 budget request?

MAGNETIC FUSION ENERGY

Dr. Davis

1. The FY 1983 budget request for Magnetic Fusion Energy totals $444.1 million, a reduction of $9.7 million from the level appropriated for FY 1982. This appears to be one program where the Department took one of the ERAB recommendations to heart. Does this proposed funding level mean that the Department no longer believes that the program is technically ready to move into the engineering development phase, and if so, what is the basis for this change?

2. Does the Department concur with the ERAB recommendation "that an enhanced effort to examine the use of fusion for the breeding of nuclear fuels deserves consideration," and if so, what additional level of effort would be recommended?

NUCLEAR ENERGY

Mr. Roddis

1. High Temperature Gas Reactor (HTGR). On page 19 of the report, it is stated that "high temperature gas reactor funding has a lower priority" than other conventional reactor systems R&D programs.

a) What was the basis for this recommendation?

b) Did the Board consider the specific advantages or disadvantages of the HTGR, or was this recommendation based on the current dismal LWR market outlook?

c) Did the Board consider the possibility of losing the HTGR option if Federal support is withdrawn?

Dr. Davis

1. High Temperature Gas Reactor (HTGR). The government has been a partner in the development of the HTGR for some time.

a) Given the Administration's pro-nuclear stance, why were no funds requested in FY 1982 and FY 1983 for the HTGR?

b) What evidence do you have that industry will continue development without further support?

c) If no such evidence of continued private development exists, what energy supply system does the Department recommend for meeting future needs of the high temperature process heat market?

2. Clinch River Breeder Reactor (CRBR). Would you comment on the proposition that completion of the CRBR may be essential, not only to demonstrate the commercial viability of breeder reactors, but also to restore confidence in the Government's commitment to the nuclear energy option, thereby providing a focus to aid in restoring the viability of the U.S. nuclear energy industry?

3. CRBR. Should we be concerned that we are falling substantially behind Japan, France and the Soviet Union in development of the breeder reactor option?

ASSUMPTIONS AND METHODOLOGY

Questions Directed at Mr. Roddis (comments could also be solicited from Dr. Davis)

1. How does the ERAB feel about Federal support of development work? Specifically, where does research begin and where does it end? Can it be said that research ends with small-scale laboratory experiments and conceptual drawings, or is it necessary, in the Board's opinion, that work continue with development at a sufficiently large scale to prove the practicality of the concept?

2. On page 10 of your testimony, you state that "ERAB is also concerned that some energy R&D of great potential significance for the achievement of the Nation's energy goals will fall between Federal and industry responsibilities." What R&D do you think is encompassed in this "gray" area?

3. On page 10 of your testimony, you note that "there are other circumstances in which it would be unrealistic to expect timely and effective assumption by industry of R&D responsibilities abdicated by the Government, however worthy the projects involved, and despite the provision of new generous tax incentives." What R&D projects do you have in mind here?

4. On page 10 of your testimony, you note that ERAB does not question the Administration's shift toward research with longer range impacts as a general proposition as long as it recognizes valid exceptions. What do you consider exceptions?

5. On page 11 of your testimony, you note that ERAB's evaluations took the Administration's policies and guidelines relative to the federal role very seriously but that exceptions had been made. What were these exceptions?

Mr. Davis

1. On page 4 of your testimony, you state: "Where programs are curtailed, we want to ensure an appropriate transition to private initiative is encouraged; where Federal programs are continued, we want to ensure coupling and technology transfer to private firms."

a) What methodology did the Department use to determine which programs are to be curtailed?

b) How is the Department proposing to ensure that coupling and technology transfer to private firms?

2. On page 5 of your testimony, you state: "Where programs are terminated, we have determined that these efforts are not appropriate for Federal support. And, if there is an economic potential, private industry will support."

a) What methodology did the Department use to determine which programs are to be terminated?

b) In the case of program termination, is the Department also trying to ensure coupling and technology transfer to private firms?

3. On page 6 of your testimony, you state that the results of the ERAB panel were not available to the Department to consider in formulating the FY 1983 budget. What assumptions and methodology did the Department employ to formulate the FY 1983 budget?

ELECTRIC SUPPLY

1. In its report, the Energy Research Advisory Board recommends that, "Demonstration of breeder technology be delayed until a future time." This statement clearly implies the termination of the present CRBR project.

   a) What economic criteria did the Board utilize in reaching this conclusion?

   b) Did the Board take into account the fact that the total estimated costs for the project had significantly increased over the last few years?

   c) What is the explanation for this increase?

   d) Does the Board believe that these costs would increase even more if the project were to go forward?

   e) What were the Board's opinions on the private share contributions to this project?

   f) When did the Board estimate a breeder should be demonstrated?

   g) Does the Board believe that there are more cost-effective means besides the breeder for providing additional energy supplies in the near future?

2. The Board is reported to foresee little commercial demand for MHD. A cited problem is the "extreme temperature/erosion" regime.

   To what extent could this problem be defined, studied, and alleviated by basic research?

3. A recent GAO report indicated that it was necessary to build a geothermal demonstration project if industry was to take over and commercialize relatively lower temperature geothermal resources. Based on this report, as well as previous testimony and information presented to the Committee, the Committee has authorized a cost-sharing binary demonstration project located in Heber, California.

   a) What is the Board's position on demonstration projects generally?

   b) Do you believe that we need a demonstration project if we are to commercialize the binary technology?

4. Mr. Davis, the ERAB report recommended a higher priority and increased funding for high burn-up fuel and safety-related research for conventional light water reactor systems. Yet, the Department dramatically cut funding for these programs.

   What is the rationale for the budget request in these areas?

5. In previous years, the fusion program was planned on the assumption of an increasing budget pie. It could therefore support the focused effort on the Center for Magnetic Fusion Engineering and eventually the Fusion Engineering Device, and at the same time continue a strong effort in a wide variety of alternative concepts.

Now, the fusion program no longer sees a growing budget, and the ERAB report recommended a decrease in the budget and a stretching out of the program.

a) How do you recommend we resolve the conflict between a focus on the Tokamak concept and a diversified number of alternative concepts such as mirror design or the Elmo Bumpy Torus?

b) Since you also recommended an enhanced effort on a fusion-fission hybrid for the breeding of nuclear fuels, are you therefore recommending more emphasis on mirror concepts since they seem to be most suited for such an application?

FUEL SUPPLY

1. The report claims a "very extensive effort in the private sector" to develop improved indirect liquefaction.

Who are these participants and for what period have they been active?

2. The ERAB report found that R&D for electric supply technology is receiving a larger proportion of funding than the present and projected share of electricity in our national energy supply. Nevertheless, programs to develop liquid fuels such as the biomass program are being severely cut back. I understand that the ERAB Board issued a report last November on the biomass program which indicated that biomass was a very promising energy resource.

Do you believe that biomass can play a significant role in meeting the nation's future liquid fuels needs, and if so, do you believe that your funding recommendations in biomass reflect this potential?

3. As you are aware, the federal coal R&D program has undergone a transformation between the Carter and Reagan Administrations.

How has this change effected the coal industry, and do you believe that the Reagan approach emphasizing long-range, high-risk activities is the most appropriate approach in this area?

4. The ERAB report criticized the emphasis of DOE programs on electricity generation, and particularly criticized nuclear programs for this. The High Temperature Gas Cooled Reactor (HTGR) is an excellent application of nuclear energy for something other than electricity generation. In fact, the FY 1982 authorization stressed the process heat generation value of the HTGR and its utility in water short regions.

a) What is the rationale of the ERAB report in recommending increased funding for the conventional reactor systems (focused on electrical generation) and recommending a low priority for the HTGR?

b) Was the application of HTGR as a fuel substitute, e.g., synfuels production, considered by ERAB?

CONSERVATION & UTILIZATION

1. One of the Energy Advisory Research Board's most significant recommendations is that conservation funding should be increased. This recommendation is based on the Board's belief that conservation should be one of the Department's highest energy R&D priorities.

a) Do you have any opinions on the best way to reorganize DOE in order to reflect this finding?

b) Do you believe that the proposed Administration DOE reorganization plan is the right approach?

2. Last year, the Science and Technology Committee held hearings on the impacts of oil decontrol on our nation's R&D programs. During these hearings, the Committee heard many comments on the appropriate role of the Federal Government in energy reserach and development.

a) What do you believe is the appropriate role for the Federal Government in energy R&D, especially in the conservation area?

b) What impacts do you believe oil, and possible natural gas deregulation, will have in the conservation area?

3. As you are well aware, there are currently many Federal tax incentives now on the books to stimulate conservation activities. These include both a residential and business conservation tax credit, as well as the new incentives included in the Economic Recovery Tax Act for capital investment and productivity.

a) What impacts do you believe that these tax credits will have in stimulating new construction investments?

b) Can these incentives take the place of on-budget Federal support in the conservation area?

4. One of the most interesting recommendations in the ERAB report was that "R&D in the transportation sector should be redirected away from its present heavy emphasis on automobile engines and toward the heavy freight truck sector." We believe that this recommendation would call for a significant reorientation in the current DOE transportation program effort. As you may know, the Committee has in the past strongly supported legislation calling for the development of advanced automobile engines such as gas turbines and Stirling engines and advanced electric and hybrid vehicles.

a) Could you please explain why this program should be reoriented?

b) Do you believe that advanced automobile engines such as the gas turbine or Stirling could be worthwhile and useful?

5. As you may know, the Science Committee has in the past strongly supported the industrial energy conservation program at DOE. This is consistent with the ERAB report recommendations. However, while supporting the program, a recent National Academy of Sciences study did find several problems with the industrial program, namely that selection procedures were weak, some questionable projects had been funded, there was a lack of communication between program personnel and industry, etc. Based on its review, the National Academy found that the, "Activity of the Office of Industrial Programs should be more focused on the support of long-range, high-risk R&D. . . ."

a) Do you agree with this recommendation?

b) What else can be done to make the industrial program more useful?

c) Will the new Federal tax incentives provided in the Economic Recovery Tax Act of 1981 be useful in stimulating increased industrial conservation activities?

6. The Science and Technology Committee has generally supported the need for solar tax credits, and in particular, the 40% residential tax credit now on the books. Do you believe that this tax credit will be sufficient in future years to stimulate a viable solar industry?

SCIENCE & TECHNOLOGY BASE

1. Relative to climate and CO_2 research and the high priority assigned by the ERAB report, what period of research do you believe necessary to obtain indicative data?

And to obtain definitive data?

2. The ERAB's report refers to general environmental programs.

a) What recommendations can you provide on the responsible group or groups to perform the work, or whether the efforts should be consolidated?

b) What are the possible duration spans of these programs?

3. Within broad programs, what priorities were assigned to significant elements?

For example, how did ERAB rate ISABELLE in High Energy Physics? How did it rate synfuels research in Health/Environmental Reserach?

CRBR

1. There is an increasing emphasis on industrial participation in energy development, and encouragement of technology transfer to industry.

If the CRBR project were to be cancelled, would't this set up the worst sort of precedent for industry cooperation, as well as mean the loss of our best people from the program?

2. The British are very enthusiastic about their breeder program. Walter Marshall, the Chairman of the United Kingdom Atomic Energy Authority, has stated that although their breeder will cost one and a half times the cost of a conventional reactor, it will still have a competitive advantage over alternative sources, such as oil-fired power plants.

Can you clarify why the Europeans believe the breeder is both necessary and economic, and the ERAP report does not?

Mr. Roddis

1. What weights were attached to each of the ranking criteria and how were these weights determined?

2. The Technological Potential criterion used to evaluate energy programs gives the highest rating to those programs with the lowest technical risk.

   a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

   b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

3. The Economic Potential criterion used to evaluate energy programs gives the highest rating to those technologies that will be competitive with the existing technologies providing energy in the year 2000.

   a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

   b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

4. The Benefit/Cost criterion used to evaluate energy programs gives the highest rating to those technologies which require the least amount of R&D investment per quad of energy produced or saved in the year 2000.

   a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

   b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

5. The Energy Security criterion used to evaluate energy programs gives the highest rating to those technologies which will displace or substitute for 2.0 million barrels per day or more of oil equivalent by the year 2000.

   a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

   b) What numerical rating did the various electric technologies receive for this criterion?

   c) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

6. It appears that the definition of the Urgency criterion used to evaluate energy programs is ambiguous at best.

   a) Would you please expand on the definition of the Urgency criterion?

b) Given this definition, which technologies would receive high rankings and which technologies would receive low rankings for this criterion?

c) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

7. At least 4 of the 7 criteria used to evaluate energy programs appear to give the highest ratings to those technologies which are short-term and low-risk.

a) Given this fact, how can the Board have adequately assessed the need for Federal support of long-term, high-risk R&D?

b) How would the rankings and recommendations of the ERAB change if these criteria were eliminated?

Mr. Davis

Please provide the Committee with breakdowns of the FY 1983 DOE budget request as in Tables III-C, III-D, III-E, and III-F of the Energy Research Advisory Board's Report of November 1981, entitled Federal Energy R&D Priorities (i.e., the FY 1983 budget as a function of technology area and energy form and as a function of energy form and timing of impact). Also, provide the Committee with updates, as appropriate, for the FY 1981 and FY 1982 budgets.

QUESTIONS SUBMITTED TO MR. DAVIS

FOSSIL ENERGY

1. Heat Engines. Why has the High Temperature Turbine Technology program been terminated when the ERAB report recommends continuation and the DOE Sunset Review recognizes the technical and environmental advantages of this technology?

Answer: The High Temperature Turbine Technology (HTTT) Program has been very successful in advancing two basic versions of several different cooling concepts. DOE believes that by the time Phase II of the program is completed in April 1982, industry will have sufficient results to validate them and produce a technology base necessary for commercial decisions. In other words, "proof of concept" will have been achieved. It would be industry's responsibility to conduct the next phase which requires full engine tests at sizes which can be scaled for baseload utility use.

It is important to note that industry already is assuming increased R&D activity in this area. A joint private program without any Federal support is underway at Southern California Edison's Coolwater generating station in which a coal gasifier will be integrated into a turbine-combined cycle configuration for the first time. While the turbine inlet temperatures at Coolwater are essentially state-of-the-art, the facility if successful will validate the gasification/combined cycle concept. It is reasonable to assume that utilities will then begin seeking the greater efficiencies obtainable at higher temperatures. As they make this progression in the late 1980's and early 1990's, they will be aided by work currently being done by EPRI to develop a turbine in the 2300° F range, a significant step toward the original HTTT temperature goal of 2500° F or above.

FOSSIL ENERGY

2. Combustion Systems. In light of the ERAB report's recommendation for continued work on pressurized fluidized bed combustors related to cogeneration applications, what rationale justifies termination of DOE involvement at the Wood Ridge and Grimsthorpe projects; the former being a cogenerator and the latter incorporating that option in the future plans?

Answer: With regard to the Grimsthorpe project, the U.S. remains committed to the completion of the viable program and Fossil Energy has requested $2.5 million in FY 1983 to complete a planned test program and to prepare final technical reports of the test program. These final technical reports should insure that the United States, United Kingdom, and the Federal Republic of Germany have an adequate base from which future decisions concerning the project can be made.

With regard to the Curtiss-Wright project, we believe the proper use of federal dollars should be to build a sound technology data base for new energy concepts. For the pressurized fluidized bed system, an adequate data base for future industrial development can be attained for the heart of the process—the combustor—from data generated by the Grimsthorpe project. In addition, $2 million has been requested to provide long-term PFB research, and consists of a coordinated series of research projects located in industrial, institutional and government facilities. While no funds were requested in FY 1983 for the Curtiss-Wright project, we are negotiating with the industrial partner to determine if private cost-sharing could be increased and the facility completed. A proposal has been received from Curtiss-Wright and is currently under review by DOE.

FOSSIL ENERGY

3. Magnetohydrodynamics (MHD). In recent testimony before two House Subcommittees Secretary Edwards expressed regret over the foreign exploitation of some technologies which the United States pioneered. By terminating the MHD program, do you not fear that our current leadership will be sacrificed to the Soviet Union among others?

Answer: The U.S. position in the various energy R&D technologies is certainly of major concern. However, I do not believe that the United States' technological leadership in the area of Fossil Energy R&D is jeopardized. While the loss of any technological edge is always of great concern, MHD is but one of four advanced fossil energy electric power producing technologies presently being pursued by the U.S. (the other three being fuel cells, PFB, and gas turbines). MHD is a technology that requires a large-scale, proof-of-concept demonstration with attendant high development cost to prove that the technology can progress to a commercial stage. And, in light of the budgetary situation, the need for fiscal responsibility, and considering the relative merits of comparable electric power producing technologies presently being pursued within Fossil Energy, the Administration has decided not to support continuation of funding for MHD.

4. Given the structure of the coal production companies and the utilities, do you see any possibility that the private sector would be able to continue development of advanced combustion techniques of fuel cells if federal funding is withdrawn? What, in your view, will happen to the scientists and engineers presently working on these projects?

Answer: Neither the utilities nor the coal production companies would be expected to continue the development of advanced combustion techniques or fuel cells by themselves. However, consortiums, such as the Coal-Water Group, can be expected to pursue advanced systems through the demonstration phase. Another example of private sector involvement would be the Electric Power Research Institute's (EPRI) funding of advanced fuel cell R&D activities. In any case, federal funding is not being completely withdrawn in either the advanced combustion or fuel cell areas. The Federal Government will continue to fund the higher risk/high payoff technology base activities.

We would hope that the scientists and engineers working on projects previsouly funded by the DOE could continue their work under private sponsorship.

GENERAL

1. Q. Were the recommendations of the ERAB report incorporated into DOE's FY 1983 budget request? Did they have any impact on the levels of funding requested? Specifically, did they have any impact on the levels requested for industrial conservation, passive solar, buildings and community systems?

   A. The recommendations of the ERAB report were only one of a number of different considerations that went into DOE's FY 1983 budget request. The ERAB report was available at a very late stage of the budget cycle, it was not available when the budget was initially formulated. The budgets for the areas mentioned had already been largely determined by the time the ERAB recommendations were available.

CONSERVATION AND RENEWABLE ENERGY

2. General. Do you agree with the statements on p. 45 of the ERAB report that "the overall level of Federal R&D funding for conservation and improved utilization is too low" and "the balance between supply-oriented R&D and conservation R&D is too heavily weighted toward the former?" If not, what evidence do you have to contradict this statement?

Answer: The Department estimates that Federal conservation programs have been responsible for no more than about 5% of the conservation in energy use that has occurred in this country since 1972. The rest of the reduction in energy use has been due to increasing energy prices and other market forces. Prior to 1973 there was little incentive to invest in measures which would improve energy efficiency. Since that time consumers and industry have found many cost-effective measures to employ to reduce their energy use. In fact, the nation has conserved seven times as much energy as we have found in new proven reserves in recent years. Unlike "supply-oriented R&D," "conservation-oriented R&D" is for the most part very cost-effective and as such should be undertaken by the private sector, rather than the Federal government. However, it is our intent, based on program and budget priorities, to continue R&D in those areas which the private sector cannot reasonably be expected to pursue, and which appear to have merit. The level of funding proposed in the President's FY 1983 Budget Request is expected to be sufficient for this task.

CONSERVATION AND RENEWABLE ENERGY

3. Buildings and Community Systems and Industry Energy Conservation. The ERAB report recommends increased funding for buildings and community systems and industrial energy conservation. Yet, it is our understanding that both of these programs are being terminated by DOE in FY 1983. How can you justify that termination in light of a strong contrary recommendations by your own panel of experts? Do you have any hard evidence to counter the justifications given by the ERAB panel for recommending increasing support for those programs, especially those relating to the inability of industry to perform the R&D on its own?

Answer: The Panel concluded that R&D in Buildings and Community Systems needs increased funding in view of the large amount of energy consumed in this sector and the lack of private sector institutions able to undertake building systems R&D. We note, however, that those served by the Buildings and Community Systems program (owners of commercial and residental buildings, and communities) have made significant improvements in their energy efficiency in recent years. New residential and commerical buildings reflect an intensifying awareness of the importance of energy-efficient design and construction. The average energy efficiencies of appliances are increasing and appliance manufacturers are increasing dissemination of information on the energy performance of their products. Even before required to do so by the Residential Conservation Service, many utilities were providing information and assistance to their customers on how to improve the energy efficiency of their homes. Communities are recognizing the importance of incorporating energy considerations in their operations and planning, and states and local jurisdictions are recognizing that it is their responsibility to determine the need for, and features of, any energy efficiency building codes. Private-sector organizations

such as the National Association of Home Builders, the American Society of Heating Refrigerating and Air Conditioning Engineers, and the American Institute of Architects are increasing their attention to the efficient use of energy. These organizations, and such others as the Gas Research Institute, and the National Association of Home Builders Research Foundation already have independent research activities. DOE anticipates that as the Federal R&D activities are reduced, these associations will expand their R&D activities. In addition, private companies, such as General Electric, Honeywell, and Whirlpool, are expected to expand their R&D as higher energy prices stmulate the market for more energy efficient products.

TRANSPORTATION ENERGY CONSERVATION

4. Q. Please give your justification for terminating the DOE R&D programs in transportation conservation, passive solar and energy storage in light of the ERAB recommendations that they be continued at level funding.

A. The recommendations of the Energy Research Advisory Board (ERAB) were but one source of input into the DOE decision making process. The ERAB recommendations were of a general nature and provided no recommendations of specific research needed. The advice given to us by this Board was, therefore, considered in the larger context of Presidential economic and energy policy.

We agree with ERAB that, in the areas of conservation and renewable energy, there exists a large potential for increasing the efficiency of the Nation's overall energy use. Our FY 1983 budget reflects the Administration's conviction that, with a realistic energy-pricing policy, the marketplace can realize this potential more efficiently and effectively than the government can. We also believe more realistic energy prices will provide adequate incentives to industry to undertake needed R&D, where considered economically beneficial.

SCIENCE AND TECHNOLOGY BASE
(ENERGY SUPPORTING RESEARCH AND GENERAL SCIENCE PROGRAMS)

1. Universities. University Research Support received a high priority, increased funding rating in the ERAB report. Why then was the University Research Support budget cut from $10 million in FY 1982 to about $5 million for FY 1983? In particular why was the modest $1 million energy traineeship program for graduate students eliminated from the FY 1983 budget request?

Answer: The FY 1983 budget request for the University Research Support Program (URS) of $5.1 million includes support for the two highest priority activities within the collection of program efforts which make up the overall URS program. These priorities are to continue providing fuel for university-based nuclear research and training reactors and to maintain support for university faculty and student-oriented research participation projects at our National Laboratories. Other URS program activities directed at graduate student support and precollege energy education and training programs were not given a higher priority for support in a constrained budget environment. This decision is also closely related to the Administration's overall philosophy on the proper role of the Federal Government in education in general and in student support in particular.

We remain concerned, however, over the national problem of the limited supply of professionals with advanced degrees in those science and engineering fields most relevant to energy R&D. The current manpower situation, particularly in engineering, has been well documented in recent studies by both the National Academy of Sciences and the

National Science Foundation. A conference was held April 7 in New York involving university, businesses, and government officials to specifically discuss possible joint actions to help alleviate the engineering manpower problem.

We in the Department will continue to do our part in manpower development by providing increased support for university research projects involving graduate students and also through the various activities of our National Laboratories in supporting undergraduate and graduate student research projects. We estimate that in FY 1981 over 6,000 graduate students were involved in DOE research either directly on university research projects or through the National Laboratories.

Specifically regarding the Energy Graduate Traineeship Program, we have proceeded to award 57 two-year traineeships in FY 1982 to 25 universities and colleges. These traineeships have been supported in the four engineering disciplines most critical to energy R&D and in which there are growing shortages of U.S. citizens with doctoral degrees. These disciplines are chemical, mechanical, nuclear, and petroleum engineering. In addition, our Fusion Energy Program has proceeded in FY 1982 to support 18 graduate fellowships in fusion technology and finally, the Nuclear Energy Program has recently initiated a graduate fellowship program in nuclear engineering and health physics to specifically address the shortages in these two essential fields. Twenty-four graduate fellowships will be supported in FY 1982 through this program.

These activities, along with our increased support for university-based research, should certainly help in the solution of the engineering manpower problem. We will continue to closely monitor this area and will work with other Federal agencies and the private sector to develop possible future joint manpower development efforts if the need arises. We will also review the need for additional DOE support for engineering traineeships in the context of the FY 1984 budget submission.

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MAGNETIC FUSION ENERGY

1. The FY 1983 budget request for Magnetic Fusion Energy totals $444.1 million, a reduction of $9.7 million from the level appropriated for FY 1982. This appears to be one program where the Department took one of the ERAB recommendations to heart. Does this proposed funding level mean that the Department no longer believes that the program is technically ready to move into the engineering development phase, and if so, what is the basis for this change?

Answer: The Department continues to believe that, from a technical standpoint, the fusion effort has reached the stage at which the existing broad physics and technology program should be complemented with an enhanced engineering effort just as was recommended by ERAB in 1980 and as indicated in the Magnetic Fusion Energy Engineering Act. Indeed, planning is underway for this phase of fusion development. Budget circumstances, however, require us to proceed in the near term at a slower pace than was previously contemplated.

2. Does the Department concur with the ERAB recommendation "that an enhanced effort to examine the use of fusion for the breeding of nuclear fuels deserves consideration," and if so, what additional level of effort would be recommended?

Answer: Of course, such an effort deserves consideration. The concept of using fusion neutrons to breed fissile fuel is not new. Breeding fissile fuel is one of many applications that may make sense if the fusion development effort is successful. However, it would be premature to invest substantial sums in the specifics of such a system until the work on fusion engineering is further advanced. At present, the same key science and technology issues must be resolved for fusion regardless of whether the ultimate chosen end use turns out to be electricity or fuel production.

NUCLEAR ENERGY

1. High Temperature Gas Reactor (HTGR). The Government has been a partner in the development of the HTGR for some time.

a) Given the Administration's pro-nuclear stance, why were no funds requested in FY 1982 and FY 1983 for the HTGR?

b) What evidence do you have that industry will continue development without further support?

c) If no such evidence of continued private development exists, what energy supply system does the Department recommend for meeting future needs of the high temperature process heat market?

Answers:

a) The Department's decision not to support the HTGR Program is based upon the large projected development costs required for the reactor and its associated, unique fuel cycle in an atmosphere of severely constrained Federal budgets along with the lack of a private sector lead plant commitment. In view of the Administration's policy on encouraging private sector participation in energy development ventures, a significant commitment by industry is essential to the future of this technology. We consider this position to be consistent with the language in the FY 1982 Budget Authorization Report prepared by the House Committee on Science and Technology. The Committee report states that before the Fiscal Year 1983 budget is acted upon, utility representatives should provide the Committee with a letter of intent to purchase an HTGR lead plant. It is our understanding that the industrial response of March 16, 1982, to the House Science and Technology Committee did not satisfy the requirement for a letter of intent. Should such a letter of intent be forthcoming, the Department will reconsider its position.

b) There is little evidence, under current conditions in the nuclear industry and with the problems facing the utilities in financing new facilities, that the HTGR system, in its current state of development, can be continued by the private sector without substantial Government support.

c) In the absence of nuclear-supplied high temperature process heat, industrial users would be dependent on the use of fossil fuels for these needs as they have in the past. Coal would be expected to meet an increasing percentage of this market requirement as the cost of oil and natural gas increases and supplies of these fuels decrease.

2. Clinch River Breeder Reactor (CRBR). Would you comment on the proposition that completion of the CRBR may be essential, not only to demonstrate the commercial viability of breeder reactors, but also to restore confidence in the Government's commitment to the nuclear energy option, thereby providing a focus to aid in restoring the viability of the U.S. nuclear energy industry?

Answer: Completion of the CRBRP project is a very important element in the U.S. effort to develop a viable commercial Liquid Metal Fast Breeder Reactor (LMFBR) electric supply option. Clinch River provides a very important intermediate scale demonstration of LMFBR technology that every foreign nation developing breeder reactors has undertaken. The research and development, engineering, construction, and operational experience that will result from completion of the Clinch River Project will be invaluable to our overall program.

The Department also strongly supports the proposition that completion of CRBRP will significantly enhance the private sector's confidence in the Government's commitment to the nuclear energy option. The industry has long viewed the breeder reactor program as being necessary to assure that the fission energy option can be relied on in the long term. CRBRP is recognized by the industry as the cornerstone of the U.S. breeder program. Thus, the advancement and ultimate completion of the project will increase private sector confidence in the fission option. This is important both from the perspective of the nuclear supply industry and the U.S. electric utilities. The Department of Energy, therefore, continues to place a very high priority on the successful completion of CRBRP.

3. CRBR. Should we be concerned that we are falling substantially behind Japan, France and the Soviet Union in development of the breeder reactor option?

Answer: We are concerned about the loss of U.S. leadership in development of breeder reactor technology from several points of view. Primarily, if we fall substantially behind other foreign nations in development of the breeder reactor option, we may lose our ability to provide leadership in the development of policies and institutional arrangements that will assure that the technology is safely developed and in accordance with our nonproliferation objectives. Another concern is that the United States, which has in the past assumed the role as a world leader in breeder development, may fall so far behind foreign nations that we will not have the breeder reactor option available to us when needed to meet future U.S. energy needs. If this occurs, we may be in the unfavorable economic situation of having to rely on a foreign country to provide us with commercial breeder capability. Past experience in relying on foreign countries for our energy supplies has shown this to be an unacceptable arrangement.

ASSUMPTIONS AND METHODOLOGY

1. On page 4 of your testimony, you state: "Where programs are curtailed, we want to ensure an appropriate transition to private initiative is encouraged; where Federal programs are continued, we want to ensure coupling and technology transfer to private firms."

a) What methodology did the Department use to determine which programs are to be curtailed?

b) How is the Department proposing to ensure that coupling and technology transfer to private firms?

Answer:

a) The methodology used in determining the mix and level of funding the FY 1983 budget was to first determine if the project, activity, or program fit the proper role for Federal support. After review by management officials, if a project was considered a long-term high-risk high-payoff effort, it met the first criteria. Activities within these programs which did not meet this criteria were dropped or curtailed. Next, since a primary object of the FY 1983 budget is to stabilize the economy and to minimize Federal expenditures, the question became, how many of these programs can we afford. Each of the programs was prioritized based on numerous non-quantifiable factors such as, does the program fulfill a unique requirement, what is the likelihood of success, how does the program compare to competing technologies, the amount of industry support, etc. Input was provided by the programs, DOE staff offices, OMB, other executive offices and others. The FY 1983 budget represents the culmination of this iterative process.

b) The Department is making every reasonable effort to transfer and transition eliminated activities to the private sector. Examples of these efforts are: The Department is currently negotiating with

Ashland Synthetic Fuels Inc. regarding the continued operation of the H-Coal Pilot Plant; DOE has negotiated with private sector participants to redistribute royalty rights to permit the completion of the planned test program for the Exxon Donor Solvent Pilot Plant; negotiations are underway with interested utilities to turn the 10 MWE Central Receiver Pilot Plant over to them; plans are for the Raft River Geothermal Plant to be turned over to the private sector in FY 1983; and negotiations are being conducted so that portions of the Regional Solar Energy Centers can be transferred to the private sector.

ASSUMPTION AND METHODOLOGY

2. On page 5 of your testimony, you state: "Where programs are terminated, we have determined that these efforts are not appropriate for Federal support. And, if there is an economic potential, private industry will support."

a) What methodology did the Department use to determine which programs are to be terminated?

b) In the case of program termination, is the Department also trying to ensure coupling and technology transfer to private firms?

Answer:

a) The budget for the energy technology programs was developed primarily by applying the following criteria: Is the proposed work long-term high-risk high-payoff research which is properly the responsibility of the Federal Government? If a given project, activity, or program were judged as not meeting this criterion, it was eliminated. If it were judged as meeting this criterion, it was then prioritized with other projects, activities, and programs which also met this first criterion. The second criterion was then applied. This criterion was: given the economic state of the country and the need to control Federal spending, how many of these projects, activities, and programs could be funded, and at what levels of activity? This final step was a painful process of examining each program and evaluating the priority of the program based on a multitude of non-quantifiable items such as: what is the likelihood of success; how does the program compare to other programs which may serve the same purpose; is there a specialized side benefit; is there industry enthusiasm, etc. Input was provided by the programs, DOE staff offices, OMB, other executive offices and others. The final FY 1983 budget request reflects the results of this process.

b) The Department is making every reasonable effort to transfer activities being eliminated to the private sector. Examples of this are: Electric Energy Systems staff have been assigned to monitor and evaluate project terminations and coordinate the transfer of R&D results to industry; negotiations are underway with utility partners to fully fund the DOE share of the 50 MWE Binary Geothermal Pilot Plant in FY 1983; and portions of the Regional Solar Energy Centers may be turned over to the private sector.

ELECTRIC SUPPLY

4. The ERAB report recommended a higher priority and increased funding for high burnup fuel and safety related research for conventional light water reactor systems. Yet, the Department dramatically cut funding for these programs. What is the rationale for the budget request in these areas?

Answer: Work in the LWR safety area is being continued in selected areas to ensure continued safety. High burnup fuel research is being phassed down as current experiments are completed. It is appropriate that any further work be performed by the private sector.

Last Question for Mr. Davis
Page 15 of Questions Submitted

The tables on pages 15 and 17 of the R&D Priorities Report were accurate at the time they were prepared last summer. They were based on statistical tables prepared by our Controller's Office, and accurately reflected the allocation of R&D funds. Both the FY 1981 and the FY 1982 numbers have changed somewhat since that time, as we now have an appropriation for FY 1982 and actual obligations for FY 1981.

March 1982

TABLE III-C

FY 81 ACTUAL OBLIGATIONS AS A FUNCTION OF TECHNOLOGY AREA AND ENERGY FORM, MILLIONS OF $

OUTPUT ENERGY FORM / Resource Base	Electricity	Fuels	Utilization and Conservation	Science and Technology Base	TOTALS
Conservation	-	-	353.6	-	353.6 (8%) [10%]
Nuclear & Fusion	1,799.3*	-	-	-	1,799.3 (38%) [49%]
Coal	67.0	553.0	37.7	-	657.7 (14%) [18%]
Solar	227.0	49.7	366.3	-	643.0 (14%) [17%]
Geothermal	156.0	-	-	-	156.0 (3%) [4%]
Oil/Gas/Shale	-	78.4	-	-	78.4 (2%) [2%]
Science and Technology Base	-	-	-	981.3	981.3 (21%)
TOTALS	2,249.3	681.1	757.6	981.3	4,669.3 [3,688.0]
(% of Total)	(48%)	(15%)	(16%)	(21%)	
[Less science and tech base]	[61%]	[18%]	[21%]		

* Centrifuge R&D Costs included, construction costs excluded.

[]signify Science & Technology Base funding excluded.

TABLE III- D

FY 82 APPROPRIATION AS A FUNCTION OF TECHNOLOGY AREA AND ENERGY FORM, MILLIONS OF $

OUTPUT ENERGY FORM / Resource Base	Electricity	Fuels	Utilization and Conservation	Science and Technology Base	TOTALS
Conservation	-	-	201.8	-	201.8 (5%) [7%]
Nuclear & Fusion	1,982.4 *	-	-	-	1,982.4 (49%) [65%]
Coal	27.8	382.2	41.1	-	451.1 (11%) [15%]
Solar	114.7	30.5	149.1	-	294.3 (7%) [10%]
Geothermal	53.5	-	-	-	53.5 (1%) [2%]
Oil/Gas/Shale	-	45.2	-	-	45.2 (1%) [1%]
Science and Technology Base	-	-	-	1,009.0	1,009.0 (25%)
TOTALS	2,178.4	457.9	392.0	1,009.0	4,037.7 [3,028.3]
(% of Total)	(54%)	(11%)	(10%)	(25%)	
[Less science and tech base]	[72%]	[15%]	[13%]		

* Centrifuge R&D Costs included, construction costs excluded.

[]signify Science & Technology Base funding excluded.

84-070 O—82—16

QUESTIONS FOR HEARING ON FEDERAL ENERGY R&D PRIORITIES

MARCH 5, 1982

FOSSIL ENERGY

Dr. Davis

1. Heat Engines. Why has the High Temperature Turbine Technology program been terminated when the ERAB report recommends continuation and the DOE Sunset Review recognizes the technical and environmental advantages of this technology?

2. Combustion Systems. In light of the ERAB report's recommendation for continued work on pressurized fluidized bed combustors related to cogeneration applications, what rationale justifies termination of DOE involvement at the Woodbridge and Grimethorpe projects; the former being a cogenerator and the latter incorporating that option in the future plans?

3. Magnetohydrodynamics (MHD). In recent testimony before two House Subcommittees Secretary Edwards expressed regret over the foreign exploitation of some technologies which the United States pioneered. By terminating the MHD program, do you not fear that our current leadership will be sacrificed to the Soviet Union among others?

4. Coal Combustion and Utilization. Given the structure of the coal production companies and the utilities, do you see any possibility that the private sector would be able to continue development of advanced combustion techniques or fuel cells if federal funding is withdrawn? What, in your view, will happen to the scientists and engineers presently working on these projects?

Mr. Roddis

1. Surface Coal Gasification. Your report alludes to a broad pilot and demonstration program outside DOE and notes that much of this effort is abroad. Regarding activities abroad, what contractual or licensing arrangements exist that will benefit our technology development if we forego such work ourselves?

2. Coal Liquefaction. Your report cited the potential support from the Synthetic Fuels Corporation as one reason to justify DOE phasing out pilot plant and demonstration hydrogenation projects. What recommendation would you make if the SFC chose not to support any direct liquefaction projects on technical grounds? Would this not indicate that further large scale developmental work needed to be done to further mature or strengthen the technology?

In the face of supply and price uncertainty in the oil market, what leads you to believe that adequate private sector effort will ensue to improve the indirect liquefaction process?

3. Heat Engines. Your report recommends effort directed at higher efficiency/higher temperature gas turbines. If this activity is terminated as proposed, what ramifications do you foresee in the international market noting the extensive Japanese effort in this area?

4. Magnetohydrodynamics (MHD). The Board foresees little commercial demand for this technology. Is this foresight based on the current market or projected 10 or 20 years in the future?

How would you characterize the technical problems that need to be overcome to develop MHD technology compared with those inherent in magnetic fusion?

5. Coal Conversion. In both coal liquefaction and gasification programs, ERAB recommended that funding could be reduced below the President's FY 1983 budget request. In your opinion, what constitutes a reasonable reduction, 10%, 20%, 50%? In the case of deep reductions, what should be the priorities - gasification, direct liquefaction, indirect liquefaction?

CONSERVATION AND RENEWABLE ENERGY

Mr. Roddis

1. General. On p. 29 of the ERAB report it is stated that "relative to their potential contributions to the solution of the near- and medium-term energy problems there is an imbalance of R&D funds between the conservation programs and those directed at supply." What exactly is meant by that? What would be a more proper balance in your view?

2. General. Do you think it was a wise decision to cut the conservation R&D budget from $311.5M in FY'81 to $126.7M in the President's FY'82 request and $17.5M in FY'83?

3. Buildings and Community Systems. It is stated, also on p. 29, relative to Buildings and Community Systems, that "private sector R&D in this area is rare because of the undercapitalized nature of the industries involved." Could you explain this statement? Does it mean, in your view, that industry will be unable to pick up the research and development activities in the buildings sector if the Federal Government terminates its programs?

4. Buildings and Community Systems. The report states that Buildings and Community Systems deserves increased funding relative to the President's 1982 request of $28 million. How much more - approximately? Double? Ten percent more? Ten times as much?

5. Industrial Energy Conservation. The report states on p. 32 that ERAB recommends that the industrial conservation program be "restored to close to FY'81 funding levels" ($67M). Why? What makes the ERAB panel believe that "short-term, high-payoff R&D will not be conducted unless federal leadership is given?"

6. Industrial Energy Conservation. If the ERAB panel saw an FY'83 budget for DOE with no funds requested for Buildings and Community Systems, no funds for Industrial Energy Conservation, no funds for Transportation Energy Conservation, no funds for passive solar, do you think the panel would characterize that budget as consistent with its R&D priorities report? Would the panel characterize it as consistent with the national interest in energy R&D? Would you, personally, so characterize it?

7. Transportation Energy Conservation. Please explain the report's recommendations on p. 31 that "the vehicle propulsion technology development program should be transferred to industry in an orderly way" and "electric and hybrid vehicle R&D should be sharply reduced."

8. Passive Solar. The report states on p. 33 that "continued federal support for basic and applied research in passive solar technology will pay high dividends. The building industry is fragmented and has no institutions capable of supporting this R&D activity." Could you elaborate on that statement? Does it mean that the DOE passive solar program deserves continued support in FY'83?

9. Biomass. On p. 27 the report states that biomass R&D is given "high priority with respect to technical potential" but "medium priority with respect to all other criteria." Could you explain that? Is it the ERAB panel's view that biomass and alcohol fuels R&D should continue at roughly FY 1983 funding levels?

10. Geothermal. The ERAB report recommends de-emphasis of the geothermal electric area where, it says, industry is capable of solving the remaining problems.

In testimony before our Energy Development and Applications Subcommittee last year, the Heber Project Manager from Pacific Gas and Electric stated that the project would be terminated without continued federal support; in this case a cooperative agreement wherein the government contribution is returned upon successful commercial operation.

If projects such as Heber are terminated, how will industry solve, or even identify, the remaining problems of commercializing this technology?

11. Inventors Program. The ERAB study concludes that the inventions program deserves relatively less emphasis since money devoted to it could be more productively used in the Energy Conversion and Utilization (ECUT) program, particularly if ECUT is restructured along the lines ERAB recommends. Yet a study by the MIT Innovations Center of inventions funded by DOE in FY 1979 concluded that a four-project sample would yield an estimated energy savings of 35.4 million bbl oil/year equivalent, which at that time equalled a societal return of $46,100 for each federal dollar expended. With this magnitude of return, what rationale was used in justifying a de-emphasis of the inventions program?

12. Electric Energy Systems. Regarding Electric Energy Systems, the Board stated on p. 22, "R&D on electricity transmission and distribution is regarded as essentially the responsibility of private industry."

a) How did the Board conclude that?

b) What quantitative data does the Board have to substantiate who in private industry will support what and at what funding levels?

c) Did the Board draft a model plan for its own reference or publication based on this quantitative data which illustrates how each area of transmission and distribution will not only be adequately pursued and by whom, but how it will be integrated in a timely manner?

d) Very basically, assuming a d.c. transmission system is a desirable research task and that private industry were to undertake research in various subsystems and components, then who would manage the conduct of the task to assure that the fragments were all integrated at least to the same voltage, much less resolve the much finer interfaces?

e) Would EPRI pick up this responsibility for all Electric Systems research?

f) Did EPRI agree to this?

g) If so, what level of funding have they confirmed in the areas previously pursued by DOE?

h) Who in private industry has committed to what bits and pieces? Specifically, what subsystems and components have not been committed to?

i) What is the Board's position on gas insulated direct burial cable, on HVDC transmission, on 1200 KV transmission (a.c.), on grid interconnections, high voltage health effects, systems architecture - especially control and enhanced communications, and the BEST facility in New Jersey?

Dr. Davis

1. General. Were the recommendations of the ERAB report incorporated into DOE's FY 1983 budget request? Did they have any impact on the levels of funding requested? Specifically, did they have any impact on the levels requested for industrial conservation, passive solar, buildings and community systems?

2. General. Do you agree with the statements on p. 45 of the ERAB report that "the overall level of federal R&D funding for conservation and improved utilization is too low" and "the balance between supply-oriented R&D conservation R&D is too heavily weighted toward the former?" If not, what evidence do you have to contradict this statement?

3. Buildings and Community Systems and Industry Energy Conservation. The ERAB report recommends increased funding for buildings and community systems and industrial energy conservation. Yet, it is our understanding that both of these programs are being terminated by DOE in FY 1983. How can you justify that termination in light of a strong contrary recommendation by your own panel of experts? Do you have any hard evidence to counter the justifications given by the ERAB panel for recommending increasing support for these programs, especially those relating to the inability of industry to perform the R&D on its own?

4. Transportation Energy Conservation. Please give your justification for terminating the DOE R&D programs in transportation conservation, passive solar and energy storage in light of the ERAB recommendations that they be continued at level funding.

SCIENCE AND TECHNOLOGY BASE
(ENERGY SUPPORTING RESEARCH AND GENERAL SCIENCE PROGRAMS)

Mr. Roddis

1. Allocation of Research Funds. Is ERAB concerned about the distribution of funds and access to major facilities among energy researchers from the national laboratories, the university community and industry?

Dr. Davis

1. Universities. University Research Support received a high priority, increased funding rating in the ERAB report. Why then was the University Research Support budget cut from $10 million in FY 1982 to about $5 million for FY 1983? In particular, why was the modest $1 million energy traineeship program for graduate students eliminated from the FY 1983 budget request?

MAGNETIC FUSION ENERGY

Dr. Davis

1. The FY 1983 budget request for Magnetic Fusion Energy totals $444.1 million, a reduction of $9.7 million from the level appropriated for FY 1982. This appears to be one program where the Department took one of the ERAB recommendations to heart. Does this proposed funding level mean that the Department no longer believes that the program is technically ready to move into the engineering development phase, and if so, what is the basis for this change?

2. Does the Department concur with the ERAB recommendation "that an enhanced effort to examine the use of fusion for the breeding of nuclear fuels deserves consideration," and if so, what additional level of effort would be recommended?

NUCLEAR ENERGY

Mr. Roddis

1. High Temperature Gas Reactor (HTGR). On page 19 of the report, it is stated that "high temperature gas reactor funding has a lower priority" than other conventional reactor systems R&D programs.

a) What was the basis for this recommendation?

b) Did the Board consider the specific advantages or disadvantages of the HTGR, or was this recommendation based on the current dismal LWR market outlook?

c) Did the Board consider the possibility of losing the HTGR option if Federal support is withdrawn?

Dr. Davis

1. High Temperature Gas Reactor (HTGR). The government has been a partner in the development of the HTGR for some time.

   a) Given the Administration's pro-nuclear stance, why were no funds requested in FY 1982 and FY 1983 for the HTGR?

   b) What evidence do you have that industry will continue development without further support?

   c) If no such evidence of continued private development exists, what energy supply system does the Department recommend for meeting future needs of the high temperature process heat market?

2. Clinch River Breeder Reactor (CRBR). Would you comment on the proposition that completion of the CRBR may be essential, not only to demonstrate the commercial viability of breeder reactors, but also to restore confidence in the Government's commitment to the nuclear energy option, thereby providing a focus to aid in restoring the viability of the U.S. nuclear energy industry?

3. CRBR. Should we be concerned that we are falling substantially behind Japan, France and the Soviet Union in development of the breeder reactor option?

ASSUMPTIONS AND METHODOLOGY

Questions Directed at Mr. Roddis (comments could also be solicited from Dr. Davis)

1. How does the ERAB feel about Federal support of development work? Specifically, where does research begin and where does it end? Can it be said that research ends with small-scale laboratory experiments and conceptual drawings, or is it necessary, in the Board's opinion, that work continue with development at a sufficiently large scale to prove the practicality of the concept?

2. On page 10 of your testimony, you state that "ERAB is also concerned that some energy R&D of great potential significance for the achievement of the Nation's energy goals will fall between Federal and industry responsibilities." What R&D do you think is encompassed in this "gray" area?

3. On page 10 of your testimony, you note that "there are other circumstances in which it would be unrealistic to expect timely and effective assumption by industry of R&D responsibilities abdicated by the Government, however worthy the projects involved, and despite the provision of new generous tax incentives." What R&D projects do you have in mind here?

4. On page 10 of your testimony, you note that ERAB does not question the Administration's shift toward research with longer range impacts as a general proposition as long as it recognizes valid exceptions. What do you consider exceptions?

5. On page 11 of your testimony, you note that ERAB's evaluations took the Administration's policies and guidelines relative to the federal role very seriously but that exceptions had been made. What were these exceptions?

March 1982

TABLE III- Y
PRESIDENT'S FY 83 BUDGET AS A FUNCTION OF TECHNOLOGY AREA AND ENERGY FORM, MILLIONS OF $

OUTPUT ENERGY FORM / Resource Base	Electricity	Fuels	Utilization and Conservation	Science and Technology Base	TOTALS
Conservation	-	-	27.0	-	27.0 (1%) [1%]
Nuclear & Fusion	1,993.2*	-	-	-	1,993.2 (62%) [92%]
Coal	-	66.8	6.5	-	73.3 (2%) [3%]
Solar	5.5	9.5	45.0	-	60.0 (2%) [3%]
Geothermal	9.8	-	-	-	9.8 <(1%)<[1%]
Oil/Gas/Shale	-	11.6	-	-	11.6 <(1%)<[1%]
Science and Technology Base	-	-	-	1,050.6	1,050.6 (33%)
TOTALS	2,008.5	87.9	78.5	1,050.6	3,225.5 [2,174.9]
(% of Total)	(62%)	(3%)	(2%)	(33%)	
%less science and tech base	[92%]	[4%]	[4%]		

* Centrifuge R&D Costs included, construction costs excluded.

[]signify Science & Technology Base funding excluded.

TABLE III-E*

FY81 ACTUAL OBLIGATIONS AS A FUNCTION OF ENERGY FORM AND TIMING OF IMPACT, MILLIONS OF $

	NEAR	MID	LONG	TOTALS
Electricity	837.3 **	542.5	869.5	2,249.3 (48%) [61%]
Fuels	96.0	542.9	42.2	681.1 (15%) [18%]
Utilization and Conservation	553.7	203.9	-	757.6 (16%) [21%]
Science and Technology Base	-	-	981.3	981.3 (21%)
TOTALS (% of Total)	1,487.0 (32%)	1,289.3 (28%)	[911.7] [25%] 1,893.0	4,669.3 [3,688.0]
[% less science & tech base]	[40%]	[35%]	(40%)	

*The timeframe for impact of the various technologies used in making the above table is given in Appendix B.

**Centrifuge R&D costs included, construction costs excluded.

[ ]signify Science & Technology Base funding excluded.

March 1981

TABLE III-F*

FY82 APPROPRIATION AS A FUNCTION OF ENERGY FORM AND TIMING OF IMPACT, MILLIONS OF $

	NEAR	MID	LONG	TOTALS
Electricity	824.9**	419.1	934.4	2,178.4 (54%) [72%]
Fuels	57.5	373.9	26.5	457.9 (11%) [15%]
Utilization and Conservation	242.1	149.8	-	391.9 (10) [13%]
Science and Technology Base	-	-	1,009.0	1,009.0 (25%)
TOTALS	1,124.5	942.8	[960.9] [32%]	
(% of Total)	(28%)	(23%)	1,969.9	4,037.2 [3,028.2]
[% less science & tech base]	[37%]	[31%]	(49%)	

*The timeframe for impact of the various technologies used in making the above table is given in Appendix B.

**Centrifuge R&D costs included, construction costs excluded.

[] signify Science & Technology Base funding excluded.

TABLE III-2*

PRESIDENT'S FY83 BUDGET AS A FUNCTION OF ENERGY FORM AND TIMING OF IMPACT, MILLIONS OF $

	NEAR	MID	LONG	TOTALS
Electricity	922.6**	292.2	793.7	2,008.5 (62%) [92%]
Fuels	14.8	66.1	7.0	87.9 (3%) [4%]
Utilization and Conservation	62.5	16.0	-	78.5 (2%) [4%]
Science and Technology Base	-	-	1,050.6	1,050.6 (33%)
TOTALS	999.9	374.3	[800.7] [37%]	
(% of Total)	(31%)	(12%)	1,851.3	3,225.5 [2,174.9]
[% less science & tech base]	[46%]	[17%]	(57%)	

*The timeframe for impact of the various technologies used in making the above table is given in Appendix B.

**Centrifuge R&D costs included, construction costs excluded.

[ ]signify Science & Technology Base funding excluded.

Mr. Davis

1. On page 4 of your testimony, you state: "Where programs are curtailed, we want to ensure an appropriate transition to private initiative is encouraged; where Federal programs are continued, we want to ensure coupling and technology transfer to private firms."

a) What methodology did the Department use to determine which programs are to be curtailed?

b) How is the Department proposing to ensure that coupling and technology transfer to private firms?

2. On page 5 of your testimony, you state: "Where programs are terminated, we have determined that these efforts are not appropriate for Federal support. And, if there is an economic potential, private industry will support."

a) What methodology did the Department use to determine which programs are to be terminated?

b) In the case of program termination, is the Department also trying to ensure coupling and technology transfer to private firms?

3. On page 6 of your testimony, you state that the results of the ERAB panel were not available to the Department to consider in formulating the FY 1983 budget. What assumptions and methodology did the Department employ to formulate the FY 1983 budget?

ELECTRIC SUPPLY

1. In its report, the Energy Research Advisory Board recommends that, "Demonstration of breeder technology be delayed until a future time." This statement clearly implies the termination of the present CRBR project.

a) What economic criteria did the Board utilize in reaching this conclusion?

b) Did the Board take into account the fact that the total estimated costs for the project had significantly increased over the last few years?

c) What is the explanation for this increase?

d) Does the Board believe that these costs would increase even more if the project were to go forward?

e) What were the Board's opinions on the private share contributions to this project?

f) When did the Board estimate a breeder should be demonstrated?

g) Does the Board believe that there are more cost-effective means besides the breeder for providing additional energy supplies in the near future?

2. The Board is reported to foresee little commercial demand for MHD. A cited problem is the "extreme temperature/erosion" regime.

To what extent could this problem be defined, studied, and alleviated by basic research?

3. A recent GAO report indicated that it was necessary to build a geothermal demonstration project if industry was to take over and commercialize relatively lower temperature geothermal resources. Based on this report, as well as previous testimony and information presented to the Committee, the Committee has authorized a cost-sharing binary demonstration project located in Heber, California.

a) What is the Board's position on demonstration projects generally?

b) Do you believe that we need a demonstration project if we are to commercialize the binary technology?

4. Mr. Davis, the ERAB report recommended a higher priority and increased funding for high burn-up fuel and safety-related research for conventional light water reactor systems. Yet, the Department dramatically cut funding for these programs.

What is the rationale for the budget request in these areas?

5. In previous years, the fusion program was planned on the assumption of an increasing budget pie. It could therefore support the focused effort on the Center for Magnetic Fusion Engineering and eventually the Fusion Engineering Device, and at the same time continue a strong effort in a wide variety of alternative concepts.

Now, the fusion program no longer sees a growing budget, and the ERAB report recommended a decrease in the budget and a stretching out of the program.

a) How do you recommend we resolve the conflict between a focus on the Tokamak concept and a diversified number of alternative concepts such as mirror design or the Elmo Bumpy Torus?

b) Since you also recommended an enhanced effort on a fusion-fission hybrid for the breeding of nuclear fuels, are you therefore recommending more enphasis on mirror concepts since they seem to be most suited for such an application?

FUEL SUPPLY

1. The report claims a "very extensive effort in the private sector" to develop improved indirect liquefaction.

Who are these participants and for what period have they been active?

2. The ERAB report found that R&D for electric supply technology is receiving a larger proportion of funding than the present and projected share of electricity in our national energy supply. Nevertheless, programs to develop liquid fuels such as the biomass program are being severely cut back. I understand that the ERAB Board issued a report last November on the biomass program which indicated that biomass was a very promising energy resource.

Do you believe that biomass can play a significant role in meeting the nation's future liquid fuels needs, and if so, do you believe that your funding recommendations in biomass reflect this potential?

3. As you are aware, the federal coal R&D program has undergone a transformation between the Carter and Reagan Administrations.

How has this change effected the coal industry, and do you believe that the Reagan approach emphasizing long-range, high-risk activities is the most appropriate approach in this area?

4. The ERAB report criticized the emphasis of DOE programs on electricity generation, and particularly criticized nuclear programs for this. The High Temperature Gas Cooled Reactor (HTGR) is an excellent application of nuclear energy for something other than electricity generation. In fact, the FY 1982 authorization stressed the process heat generation value of the HTGR and its utility in water short regions.

a) What is the rationale of the ERAB report in recommending increased funding for the conventional reactor systems (focused on electrical generation) and recommending a low priority for the HTGR?

b) Was the application of HTGR as a fuel substitute, e.g., synfuels production, considered by ERAB?

CONSERVATION & UTILIZATION

1. One of the Energy Advisory Research Board's most significant recommendations is that conservation funding should be increased. This recommendation is based on the Board's belief that conservation should be one of the Department's highest energy R&D priorities.

a) Do you have any opinions on the best way to reorganize DOE in order to reflect this finding?

b) Do you believe that the proposed Administration DOE reorganization plan is the right approach?

2. Last year, the Science and Technology Committee held hearings on the impacts of oil decontrol on our nation's R&D programs. During these hearings, the Committee heard many comments on the appropriate role of the Federal Government in energy reserach and development.

a) What do you believe is the appropriate role for the Federal Government in energy R&D, especially in the conservation area?

b) What impacts do you believe oil, and possible natural gas deregulation, will have in the conservation area?

3. As you are well aware, there are currently many Federal tax incentives now on the books to stimulate conservation activities. These include both a residential and business conservation tax credit, as well as the new incentives included in the Economic Recovery Tax Act for capital investment and productivity.

a) What impacts do you believe that these tax credits will have in stimulating new construction investments?

b) Can these incentives take the place of on-budget Federal support in the conservation area?

4. One of the most interesting recommendations in the ERAB report was that "R&D in the transportation sector should be redirected away from its present heavy emphasis on automobile engines and toward the heavy freight truck sector." We believe that this recommendation would call for a significant reorientation in the current DOE transportation program effort. As you may know, the Committee has in the past strongly supported legislation calling for the development of advanced automobile engines such as gas turbines and Stirling engines and advanced electric and hybrid vehicles.

a) Could you please explain why this program should be reoriented?

b) Do you believe that advanced automobile engines such as the gas turbine or Stirling could be worthwhile and useful?

5. As you may know, the Science Committee has in the past strongly supported the industrial energy conservation program at DOE. This is consistent with the ERAB report recommendations. However, while supporting the program, a recent National Academy of Sciences study did find several problems with the industrial program, namely that selection procedures were weak, some questionable projects had been funded, there was a lack of communication between program personnel and industry, etc. Based on its review, the National Academy found that the, "Activity of the Office of Industrial Programs should be more focused on the support of long-range, high-risk R&D. . . ."

a) Do you agree with this recommendation?

b) What else can be done to make the industrial program more useful?

c) Will the new Federal tax incentives provided in the Economic Recovery Tax Act of 1981 be useful in stimulating increased industrial conservation activities?

6. The Science and Technology Committee has generally supported the need for solar tax credits, and in particular, the 40% residential tax credit now on the books. Do you believe that this tax credit will be sufficient in future years to stimulate a viable solar industry?

SCIENCE & TECHNOLOGY BASE

1. Relative to climate and CO_2 research and the high priority assigned by the ERAB report, what period of research do you believe necessary to obtain indicative data?

And to obtain definitive data?

2. The ERAB's report refers to general environmental programs.

a) What recommendations can you provide on the responsible group or groups to perform the work, or whether the efforts should be consolidated?

b) What are the possible duration spans of these programs?

3. Within broad programs, what priorities were assigned to significant elements?

For example, how did ERAB rate ISABELLE in High Energy Physics? How did it rate synfuels research in Health/Environmental Reserach?

CRBR

1. There is an increasing emphasis on industrial participation in energy development, and encouragement of technology transfer to industry.

If the CRBR project were to be cancelled, would't this set up the worst sort of precedent for industry cooperation, as well as mean the loss of our best people from the program?

2. The British are very enthusiastic about their breeder program. Walter Marshall, the Chairman of the United Kingdom Atomic Energy Authority, has stated that although their breeder will cost one and a half times the cost of a conventional reactor, it will still have a competitive advantage over alternative sources, such as oil-fired power plants.

Can you clarify why the Europeans believe the breeder is both necessary and economic, and the ERAP report does not?

Mr. Roddis

1. What weights were attached to each of the ranking criteria and how were these weights determined?

2. The Technological Potential criterion used to evaluate energy programs gives the highest rating to those programs with the lowest technical risk.

a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

3. The Economic Potential criterion used to evaluate energy programs gives the highest rating to those technologies that will be competitive with the existing technologies providing energy in the year 2000.

a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

4. The Benefit/Cost criterion used to evaluate energy programs gives the highest rating to those technologies which require the least amount of R&D investment per quad of energy produced or saved in the year 2000.

a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

b) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

5. The Energy Security criterion used to evaluate energy programs gives the highest rating to those technologies which will displace or substitute for 2.0 million barrels per day or more of oil equivalent by the year 2000.

a) How does this criterion adequately assess the need for Federal support of long-term, high-risk R&D?

b) What numerical rating did the various electric technologies receive for this criterion?

c) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

6. It appears that the definition of the Urgency criterion used to evaluate energy programs is ambiguous at best.

a) Would you please expand on the definition of the Urgency criterion?

b) Given this definition, which technologies would receive high rankings and which technologies would receive low rankings for this criterion?

c) How would the rankings and recommendations of the ERAB change if this criterion was eliminated?

7. At least 4 of the 7 criteria used to evaluate energy programs appear to give the highest ratings to those technologies which are short-term and low-risk.

a) Given this fact, how can the Board have adequately assessed the need for Federal support of long-term, high-risk R&D?

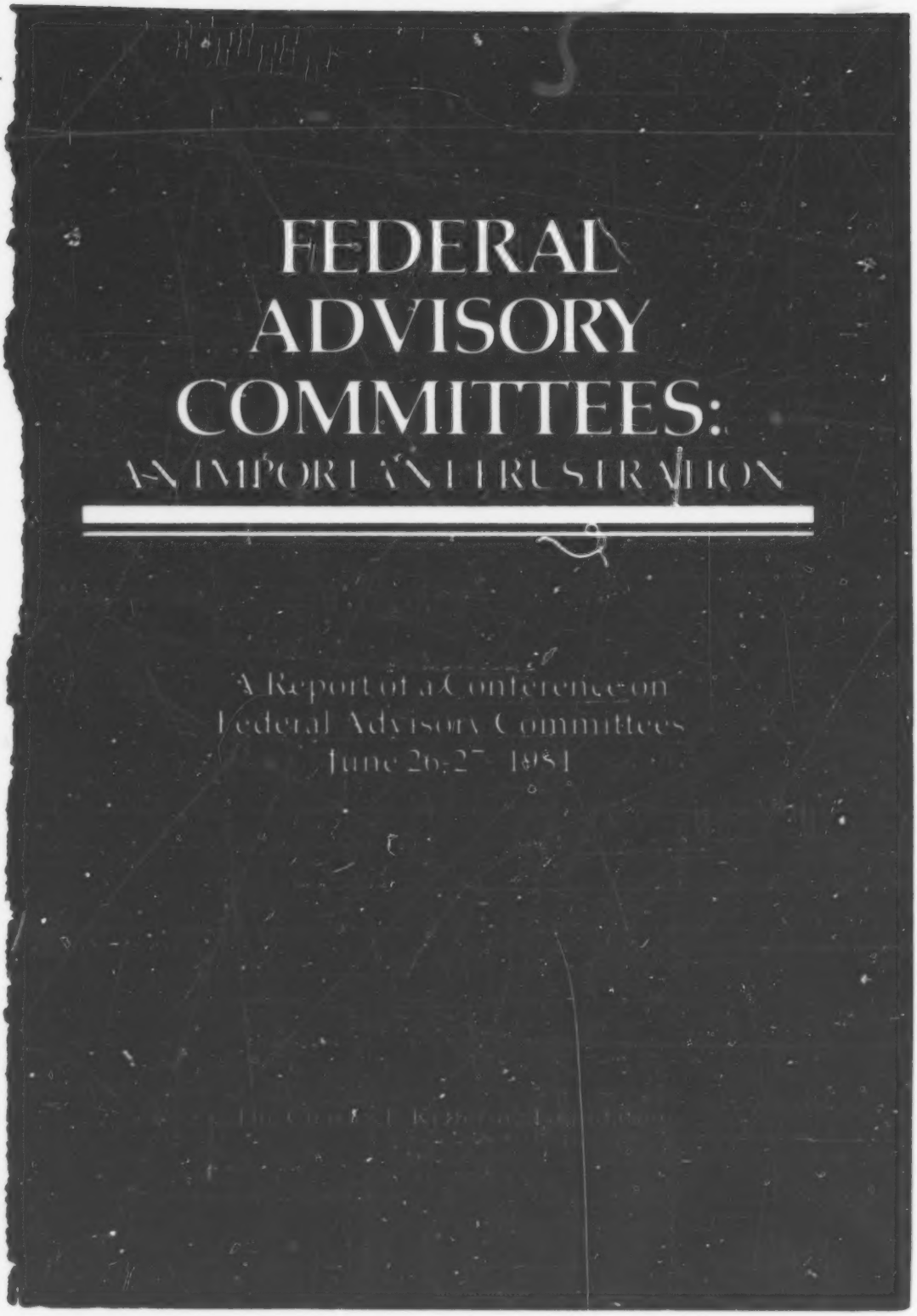
b) How would the rankings and recommendations of the ERAB change if these criteria were eliminated?

Mr. Davis

Please provide the Committee with breakdowns of the FY 1983 DOE budget request as in Tables III-C, III-D, III-E, and III-F of the Energy Research Advisory Board's Report of November 1981, entitled Federal Energy R&D Priorities (i.e., the FY 1983 budget as a function of technology area and energy form and as a function of energy form and timing of impact). Also, provide the Committee with updates, as appropriate, for the FY 1981 and FY 1982 budgets.

APPENDIX II

ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD



Federal advisory committees are a source of frustration to just about everybody involved:

- **the members**
- **the agencies**
- **the White House**

Although they are a frustration, they have become an integral part of the policymaking process. Today, even the most vocal critics of advisory committees recognize that government must be able to get advice from knowledgeable and experienced citizens from all sectors of society. Advisory committees are an important element in making government responsive.

One of the conclusions of the conference was that a wider group of federal advisory committee members (past and present) should be involved in a thorough reassessment of federal advisory committees. The "advisory committee system," said participants, "is perhaps the most 'underutilized' network linking government and citizens."

The case for the citizen's role in public policy can be made easily, and the issue runs deep throughout American tradition.

In classical democratic theory, participation is both "right," in that it gives people just control over their destinies, and it is beneficial, in that it is educational and thereby heightens appreciation for the common good. Citizens have been taking control and participating in a myriad of ways.

The Roots of Federal Advisory Committees

The use of advisory committees goes back to President George Washington, who brought together a group of citizens to help quell the "whisky rebellion."

More recently, advisory committees gained broader popularity during the Kennedy and Johnson administrations when Great Society projects ushered in the new era of citizen involvement. During this period, the federal government sought to include the poor and disenfranchised in decisions affecting their lives.

However varied the use and makeup of these committees over the years, Congress and the presidents have shaped the advisory committee system into an important resource for making public policy.

Public participation through federal advisory committees has grown dramatically since the early sixties, leading to a system in which, today, 25,000 people advise the government on everything from nuclear power to child welfare. Citizens, working with government professionals, have helped to shape policy, to advise on scientific and social research, and sometimes to build a consensus among conflicting viewpoints.

A Political Paradox

Perhaps the most important and complicating factor in the operation of government advisory committees is that they operate as part of a political milieu. The laws and the agendas a particular administration adopts reflect both the administration's desire to use advisory committees and its need to maintain public credibility. Advisory committee members often learn that their experiences working with the government can be as diverse, as exciting, and even occasionally as disappointing as our system of government itself.

This kind of participation, states David Mathews, president of the Charles F. Kettering Foundation, has worked to add a new dimension to the precept that governments exist by the consent of the governed. "Informed participation, not simply participation," is the cornerstone of representative democracy, Mathews maintains.

In June of 1981, the Kettering Foundation sought to open a window into the world of federal advisory committee service. Fourteen citizens serving on federal advisory committees were brought together with top-level federal officials who work with advisory panels. They came to probe the problems and the effectiveness of this form of participation.

The purpose of this report is to present the frustrations and concerns from a number of perspectives and to reflect the search for solutions.

The questions are being debated in a review of the effectiveness of the federal advisory system by:

the members
the agencies
the White House

Should a New President and New Cabinet Officers Receive Resignations from All Advisory Committee Members?

Members of advisory committees are often associated with a political viewpoint. This fact alone can throw an advisory group's work into limbo when there is a change of administrations. Some officials question whether many advisory committees are really needed and note that the government can obtain ad hoc advice through other kinds of public participation without the encumbrances and expense of establishing committees. But what federal officials are most frustrated by is government's lack of control over advisory committees.

Top administrators cannot control public access to the groups they hope will frankly consider issues and quietly offer advice. Often they cannot guide the advice they receive or forecast the public furor it may create. There is fear that a federal advisory committee can create its own constituency for a special point of view and generate a groundswell of public opinion before the government has a chance to consider all the alternatives. Several of the conferees agreed that while such a development may be exciting and interesting to the public, it is usually ineffective.

"If an advisory committee is independent, truly independent so it can speak and advise with its own insight, then it may not have access to governmental decisionmakers because those governmental decisionmakers will feel the committee is a 'loose cannon,' a 'wild card,' not loyal. On the other hand, lack of independence may lead to lack of credibility with the constituencies that need to be represented and whose ideas need to be reflected in decisionmaking," said one participant at the Kettering-sponsored meeting.

Some at the conference argued that there is a need for citizen advocacy in government. "Advisory committees are an extension of input into government from citizens—a necessity for a democracy. To gear the work of a committee to the issues without creating an advisory-for-advocacy relationship on the issues which the committee is asked to address is to weaken the whole process."

Last November's election gave conference participants the most recent opportunity to consider what happens to advisory committees when there is a change of administrations. There is concern about a conflict between the political beliefs and goals of the committee members and those of a changed administration, and the new administration must be concerned about realistic political questions such as how to reward campaign workers.

"One department considered asking for resignations from all members of its advisory committees," stated a government representative. An alternative course of action would be to stagger terms for advisory committee members. The latter would encourage continuity while allowing a new administration to have influence over some appointments.

Is it politically naive to expect an advisory committee whose members are inconsonant with an administration to be effective? "I suggest that the amount of resources committed to an advisory committee, the support of its findings, and the general satisfaction with the process will be greatly enhanced if the new administration can appoint all of the members," said one federal participant.

What Controls the Operations and Spending of Federal Advisory Committees?

In 1980, the government spent $88 million to operate 865 advisory committees. There were 52 presidential committees, 229 authorized by federal agencies, and 612 authorized or directed by law.

The 1972 Federal Advisory Committee Act (FACA) outlines the requirements governing the establishment and operation of committees that advise the federal government. While this law does not require or advocate that such committees be established, it states that if the president or an agency seeks advice outside of government on a continuing basis, the group's membership must be "fairly balanced" to represent a variety of views and that the committee must publish notice of its meetings and make those meetings "open to the public." The law, intended by Congress as a check on the possible abuse of public funds, was first proposed because some government officials had been using committees of experts brought together by private industry and private interest groups. It was designed, in part, to prevent the business world from exerting undue influence on government policies and on rules and regulations from which it stood to gain financially.

Has the Open Meeting Become a Two-Headed Dragon?

Under the Freedom of Information Act (FOIA) advisory committees are obliged to fill any request for documents pertaining to their operation and deliberations. The Government in Sunshine Act (GISA) further requires that federal advisory committee meetings be open to the public, subject to specific exceptions.

Federal representatives at the conference said the requirements of these three laws can make federal officials reluctant to establish advisory panels in the first place. When the government faces a controversial decision, they pointed out, it is awkward and frustrating

to discuss every aspect of a problem in public.

"Why do I hesitate to create a federal advisory committee?" one conferee asked. "The open meetings, the possible application of the Freedom of Information Act, the requirement for balanced representation... the use of the *Federal Register* and the creation of, perhaps, a dragon that will not die naturally. Of these the most serious consideration is the open meeting. Cabinet officials are concerned about whether a report drafted 'in the glare of publicity' will be frank and useful."

What is the Relationship Between the "New Federalism" and Federal Advisory Committees?

Because the current administration has proposed transferring more government responsibility to the states, some of the federal officials pointed out that the country's large system of federal advisory groups may not remain relevant. The administration officials cited hearing demands for a New Federalism from both Democratic and Republican voters. One federal official suggested: "So what does all this mean to advisory committees? If the President cuts back on government, if the role of government shrinks, will the role of citizen advisory committees need to shrink also?"

Does Government Let the Citizen Advisors Know What is Expected of Them?

Before committee members can consider their effectiveness, it is important, the conferees agreed, that they decide why they exist and how they wish to proceed. A clear statement of mission and responsibility is important. Advisory bodies should have an idea of their limitations as well as their goals and avoid working under the disadvantage of unrealistic expectations. Committees do not want to be asked questions if agencies cannot accept the answers.

One federal committee member said he found his group "important, but not very effective. The committee was appointed, I assume, because somebody thought that it

would be a good idea to have an advisory committee. The problem was, we never had any kind of agenda," he explained.

Lines of communication must be established between the agency head and the advisory group. Many conferees believed there is no substitute for communication with and access to top-level federal officials. A committee needs to understand how its mission relates to government's agenda.

Can We Define "Fair Balance" in Selecting Advisory Committee Members?

An advisory committee's membership is a key factor. The law (FACA) requires a membership which is "fairly balanced in terms of points of view represented and the functions to be performed." There is little guidance or help given to appointing officials on how to achieve "fair balance."

Current committee members said people should be selected for their competence and expertise, and that it is important to have diverse representation—generalists as well as specialists. The stature and experience of members on an advisory panel can be a factor in winning the confidence of federal officials, Congress, and the public.

A number of conferees suggested that an attempt to achieve ethnic or political balance on a committee can present problems. Certainly, if political reward becomes the most important criterion, the appointee's ability to contribute effectively is compromised. On the other hand, political appointees are valuable; as representatives of a particular administration, they lend credibility to and spark interest in the committee's work. Symbolic inclusion of members from poor and minority groups, some conferees believe, is not a guarantee that the people selected represent those constituencies.

Who Controls the Staff and the Budget?

Relations between a committee and its staff were described at times as frustrating because of the staff's need to serve two masters.

"The staff is often provided by the agency that is soliciting the advice, and that agency generally has a notion of what the advisory committee ought to do. Yet the advisory committee would like to keep some independence and simply not be the slave of an agency," stated one committee member.

Advisory groups can be rendered ineffective if they have no control of their budgets. Conferees said it takes no time at all for government officials to figure out the most effective way to stop a flow of information they deem contrary to their interests. One advisory committee member outlined a typical scenario: "The budget comes to us as the agency decides it will come. As a result, we started out holding six meetings a year, reduced to five meetings a year, reduced to four meetings a year. We are now down to three meetings a year."

Can an Advisory Committee be Effective?

When a committee makes recommendations or a report, it ought to receive a point-by-point response from the agency. Committees need to be "plugged into" the agency's policymaking process. One of the conferees said his committee made certain its work would be noticed by sending a copy of the discussion and recommendations from each meeting to the congressional panel that established the group, as well as to the administrator they were advising: "We insisted from the very beginning that we would not be an effective committee unless we got feedback from the administrator about what he would do with our recommendations."

By its assertiveness, this committee ensured that as many as 70 to 75 percent of its recommendations were accepted and used. Timidity in expressing opinions can render an advisory committee ineffective more quickly than anything else. "The worst fault of a committee is not being courageous enough."

The quality of the chairman's leadership and the ability of the committee members to work together were concerns heard throughout the conference discussions. Orientation, training, and education for federal officials and committee members were also identified as key elements for avoiding the frustration of having work rendered ineffective.

Can a Citizen be Successful?

Despite the barriers to a committee's functioning smoothly and presenting its point of view to the government effectively, it was clear that at least a few committees have been successful.

"We met every six weeks, not by law, but because we wanted to," explained one participant. "Subcommittees met as often as every three weeks. The committee members were very busy people, people who felt, because of the effectiveness of what they were doing, they wanted to do more and more."

What Next?

At the conclusion of the conference, it was clear that those who serve on advisory panels have a strong belief in the value of such groups.

At the same time, government officials expressed concern about the difficulty of working in an atmosphere of total public access. Some thought certain legal requirements seemed to impede rather than promote public participation. Others believed the problems of openness and access, power and control, communication and the timing of decisions, length of terms, committee leadership, staff, budget, and accountability were better resolved through administration and management by top-level officials committed to the process than through the creation of more laws.

It was clear from this initial discussion that there is a need to search for ways to improve the federal advisory committee system. Attention needs to be focused on how to achieve balanced membership and a diverse mix of credible views on committees. Committee members need to be informed about how they can function more effectively. Government officials need to be educated about how they can manage the committees with greater flexibility and sensitivity.

With this discussion and the research that is under way, the Kettering Foundation will focus on improving the functioning of federal advisory committees as one means of achieving better public policy.

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